WATERPROOFING TEXTILE FABRICS

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Containing the formulæ of the principal processes in use in the United States and many employed in other countries.

Written especially for the information of Textile Manufacturers, Dyers and Merchants.

WITH

An index of United States, British, French and German Patents.

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PREFACE

The two years' work entailed in the preparation of the manuscript of this book was undertaken at the invitation of the publishers, who observed the need of an authoritative textbook on the subject of fabric waterproofing—a little-understood art having a very meagre literature.

Most of the information regarding formulæ and processes given herein has never before been published. It is, however, derived from absolutely trustworthy sources in the industry itself; but the nature of this information has made it necessary to avoid connecting the various processes with the names of the concerns who use them, in order to protect those workers in the industry from whom the information has been derived.

The work has been written more for the information of the *user* of waterproofing than for those experienced in the art; but I believe it is written with sufficient conciseness to act as a technical guide to anyone, having experience as a dyer or finisher of piece goods and therefore knowledge of the handling of the material to be processed, who may wish to go into the waterproofing industry.

Most of the machinery used in waterproofing fabrics being the same as that employed in dyeing and finishing plants, I have dwelt more fully on formulæ and processes rather than on apparatus. I have only used sketches and photographs where necessary to illustrate the text. The sketch of the cuprammonium plant is used in connection with the first authentic description of that process ever published.

The thirty years' patent index is based upon special searches made at the Patent Offices of Washington, London, Paris and Berlin respectively. It only includes fabric-coating patents when the coating is specifically for a waterproofing purpose or where the formula of a coating is suitable for waterproofing.

My thanks are due, and hereby tendered, to Dr. F. P. Veitch of the Leather and Paper Laboratory of the United States Department of Agriculture for permission to use portions of his publications on open-air waterproofing, testing methods and the effect of sunlight on waterproofed cotton goods and to the publishers' President, Mr. F. W. Robinson, for his many helpful suggestions.

HERBERT P. PEARSON.

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May, 1924.

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WATERPROOFING TEXTILE FABRICS

CHAPTER I.

Introductory.

Definition of Terms.

A suitable text for a treatise on Waterproofing Textile Fabrics may well be the emphatic and oft-reiterated declaration of the president of a nationally known waterproofing concern that: "you can't waterproof a hole," for it will be shown that the imperviousness of a fabric to water varies more or less directly with the closeness of its pores, that is to say, the smallness of the "holes" in it. It is obvious that water can penetrate anywhere where air can, provided the pressure is great enough.

A logical definition of the adjective *waterproof* is: "impervious to water under the conditions obtaining during use." The dictionary definition is "impervious to water" and the dictionary definition of *impervious* is "not to be passed through or penetrated." Manifestly then, no fabric is waterproof in the strict sense of the term unless it is free from holes large enough to permit water to penetrate at the maximum pressure to which the fabric may be subjected under the conditions of its exposure. Hence no fabric which is exposed to the considerable pressure of falling rain, driven by wind, can be said to be genuinely waterproof unless its pores or air holes

are permanently stopped up, or sufficiently reduced by an impervious filling or coating.

Unfortunately the term "waterproofing" is used very loosely to describe fabrics which have been treated so as to become merely water-repellent or water-resistant, by processes which reduce the absorptive power of the fibers for water—often alluded to in the textile trade as "cravenetted."[1] A much better generic adjective to describe such fabrics is: "water-resistant," though for the purpose of this work the general title "waterproofing" will be taken to include the consideration of merely water-resisting processes. In the interests of clarity, however, *waterproof* will only be used where filling or coating is used, producing fabrics that become air-resistant also. Processes, on the other hand, which make no attempt to close or materially reduce the pores, leaving them more or less free to the passage of air will be referred to by the term *water-resisting* and the resulting fabrics will be described as *water-resistant.*

Note, therefore, that in the following pages

WATERPROOF means:

IMPERVIOUS TO WATER,
AND AIR-RESISTANT

WATER-RESISTANT means:

RESISTANT TO WATER
AND POROUS TO AIR

[1] The word "Cravenette" is registered as a trade mark in most of the countries of the world; but in the clothing industry of the United States it is used erroneously in a generic sense to describe raincoatings treated by a water-resisting process, to distinguish them from rubberized cloths.

CHAPTER 2.

Basic Principles.

Surface Tension.

How does a fabric that is porous to air resist the penetration of water? The answer is: by the presence of substances in or on the fiber which have the property of properly changing the surface tension between the water and the substance of the fiber. To explain this reference is made to the following sketches Figures 1, 2, and 3.

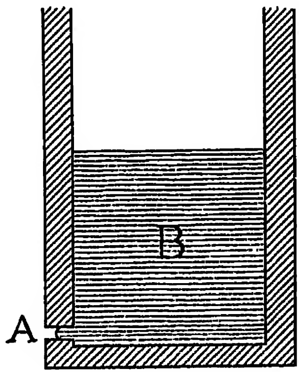

FIG. 1.

Figure 1 shows the vertical section of a glass cylinder with a hole A, about one millimeter in diameter, bored through the glass close to the bottom. B is a quantity of water which does not flow through the hole A. That

is because the walls of hole A have been covered with a fine layer of paraffin wax by moistening them with a solution of the wax in ether and allowing the ether to evaporate. Without the wax, the water would, of course, run away through the hole A. What holds the water back? The change in the surface tension between the water and the solid surface with which it is in contact. The surface tensions between water and glass on the one hand and water and wax on the other are so different that in the latter case the water is held back by the tension in the manner shown in Figure 2, which is an enlarged

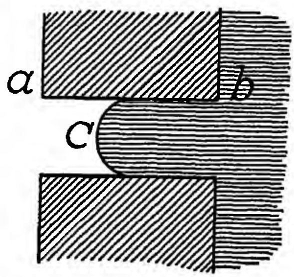

FIG. 2.

vertical cross section of the hole A. The convex formation of the water at *c* is similar to that produced when a glass of water is filled to the brim as in Figure 3. The surface of the water rises above the level of the edge of the glass and the tension of the surface D is so strong that a small needle thoroughly oiled can with care be floated on its surface. By sprinkling the surface of the water with zinc stearate, or some other powder capable of varying the surface tension in the same direction, quite heavy objects such as a safety pin, for instance, can be floated on the surface. The same object smeared with soap, however, thus varying the surface tension in the opposite di-

rection, could not be so floated because the surface would be broken.

To return to the cylinder; the height to which the water can be raised in B depends on three influences: (1) The length of the hole from *a* to *b*. The higher the level of the water is raised, the further towards *a* is the surface *c* of the water pushed. (2) The diameter of the hole A. The less the diameter the higher the water can

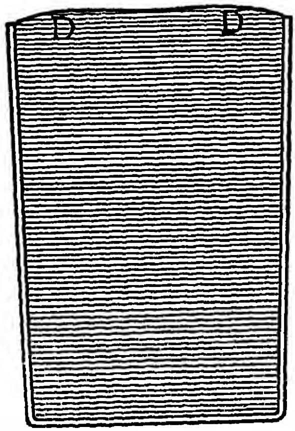

Fig. 3.

be raised. (3) The efficacy of the substance used for coating the walls of the hole A in changing the surface tension.

Similarly the resistance to penetration of a water-resistant rain coating, for instance, depends on: (1) The thickness of the fabric, i.e., the length of the pores or holes in the fabric. (2) The diameter of the pores or holes. (3) The pressure of the water to which the fabric is subjected. (4) The efficacy of the treatment given to the fabric.

The thicker and closer the weave of the fabric, the

greater will be its resistance to the penetration of water. The greater the pressure of the water due to wind, to the momentum of the rain drops or to other physical pressure, the less will be the water resistance of the fabric. That is why a light weight raincoat, the cloth of which has been treated with a water-resisting process, withstands the penetration of a light shower or gentle rain, but permits part of a heavy rain or shower driven by a stiff squall to seep through the shoulders.

Permanence.

The undoubted deterioration with age in the resistance of water-resistant fabrics is often attributed by the uninitiated to the "evaporation of the waterproofing substances away from the fabric." It is, of course, due to the fact that common dirts all have the opposite effect on the surface tension to that of the water-resisting agents and, consequently, the dirtier a fabric gets, the less it resists penetration. The author has exposed a piece of raincoat fabric, treated so as to have a brisk water resistance, for three weeks on a factory roof in winter and found at the end of that time that the water resistance had disappeared. That is to say, the exposed fabric, on testing, resisted no better than a sample of the same fabric which had not been water-resisted. It was, of course, very much soiled by the effects of the soft coal smoke.

It is nevertheless quite certain that some of the formulæ used for the purpose of water resistance do undergo physical or chemical changes on continued exposure to *clean* air which cause deterioration in the water resistance. Thus, anyone wishing to find out which of a number of formulæ are best for water resistance under practical conditions of wear and tear, should expose comparative samples to clean, country air before testing them.

CHAPTER 3.

The Value of Water-Resisting Processes on Fabrics.

Heavy Cottons.

Ducks and canvas goods should never be used as paulins or covers without a treatment of some kind. A thorough impregnation with a heavy water-resisting mixture containing mildew-resisting substances is highly desirable, not only to resist penetration of water but to resist the added weight caused by absorption of water and to prevent the formation of mildew after absorption of water. The quantity and quality of these treatments is unfortunately largely determined by the method of buying waterproofing pursued by manufacturers, who in general buy price rather than value. Waterproofing treatments can be purchased by the trade today which will prevent the penetration of water under the severest possible conditions to which the article can be subjected and which will resist mildew under the worst of adverse influences. But such a treatment costs more money than most manufacturers are willing to pay. The result is that waterproofing, like paint, can be purchased at a wide range of prices and there is just as much "bunk" used in the selling of the one as the other.

There is a great need of a trade association of cotton waterproofers to standardize processes and tests and to banish from the trade, formulæ and treatments which do not give results that can be shown to be of dollars-and-

cents value to the ultimate user of the goods. If such an association were formed, waterproofings could be graded according to cost and the manufacturer educated to the fact that all duck and canvas should be waterproofed and that the treatment should be selected in accordance with the severity of exposure to which the manufactured articles are liable to be subjected. As it is, there is no attempt whatever at coöperation amongst waterproofers, who are consequently forced to cut profits down to the limit of insignificance and resort to all kinds of tricks to obtain business.

One waterproofer A has been using the same processes without change for forty years, during which time no manufacturer has ever troubled to find out whether the goods treated by him really were waterproof or mildew-proof. These processes continue to be sold because, in the words of the waterproofer, "they have stood the test of time." The "test of time" fell down very badly under observation of army authorities during the World War!

Another waterproofer B—more careful and conscientious in the matter of testing—after developing a process which really was calculated to give satisfactory results to the ultimate consumer, was "forced" by price competition to cut down important ingredients and to deliver to the manufacturer a treatment which he knew was neither sufficiently water-resisting nor mildew-proof. The only comfort he could have had was probably the knowledge that the process, the price of which he had to meet, was, if anything, more deficient than his.

Each of these types of waterproofer, A or B, guards his secret processes most jealously and believes them to be valuable, although they earn little profit for him. If they would all get together in a national association, the manufacturer could be educated to buy values, A would improve his processes, B would supply better treat-

ments, both would make much more money and the ultimate consumer would be better protected from water and mildew.

Clothing.

It seems extraordinary that in this day and age of scientific development, manufacturers, dyers, and finishers turn out the fabrics, which go to make the clothing we wear, in such a state that they are well-nigh as absorbent as blotting paper to one of the most prevalent natural elements: water.

During the war, millions of soldiers tramped through the drizzle carrying two to four pounds of quite unnecessary weight in the form of water absorbed by their woolen overcoats. Hundreds of tons of water were carried about in this way and a corresponding quantity of human energy was wasted. This could have been reduced 70 per cent by proper treatment of the woolens at a cost of less than a dollar per man.

In peace time millions of dollars' worth of women's fabrics are soiled and spoiled by absorption through accidental contact in the course of ordinary wear with water or aqueous liquids. It is not necessary to point out the desirability and value of water-resisting treatments on such fabrics. It is in this field that scientific research and coöperative endeavor are most required.

Under present conditions, more or less heavy woolens are being treated for coats and sports' wear, while silks and light dress goods can be successfully water-resisted—without change in either porosity or appearance where the previous processes of finishing allow. But all the treatments are either removed entirely or greatly deteriorated by the process of dry-cleaning, which is growing so rapidly in popular favor. Further consideration of this important subject will be found in Chapter 9.

CHAPTER 4.

Processes under Consideration.

Only processes that are or have been in practical use on the large scale in the United States, Great Britain, Austria and France will be mentioned in succeeding chapters. Most of the patents that have been taken out on the subject of this work are ignored, except in Chapter 10, for the very good reasons that they are either infringements of previously known processes that were never patented or else that the processes they describe have never reached practical employment on the large scale. The reader will doubtless agree that laboratory or small-scale processes or emergency war formulæ which have never been tested for cost and practicability as large-scale operations are of no present practical use to him. Apart from the brief expounding in Chapter 2, of the scientific principles underlying the arts of waterproofing and water-resisting, the reader, it is presumed, is not likely to gather much useful information from mere theory. Consequently, an effort has been made to constitute this work as practical a guide to those arts as is possible through the medium of printers' ink.

The successful waterproofing of fabrics is as much an art as the dyeing, though the technique of the former is less difficult of acquirement and requires less natural aptitude. It is believed that the information in this book is sufficient to enable any practical textile mill man or dyer to start waterproofing or water-resisting by one of the simpler processes, if he has the assistance of someone who

has had practical experience in the art of handling any large-scale textile piece-goods processes.

No trade-marks, trade names or names of waterproofing concerns will be used in connection with processes described for the reason that trade secrets will be disclosed without damage to the owners. These secrets generally consist more in specific technique than in the general principles underlying formulæ and application.

The processes will be considered under the two broad classifications of the articles into which waterproof and water-resistant fabrics are made, namely: *Heavy Cottons* and *Clothing.* Under Heavy Cottons are included all the cotton fabrics out of which paulins, tarpaulins, wagon covers, dunnage, etc., are made. Clothing will include garments and sporting goods, ***but not goods made of rubberized fabrics.***

The subject of applying rubber to fabrics is an art by itself not generally included in the consideration of waterproofing, yet, paradoxical as it may appear, properly rubberized fabrics make the only genuinely waterproof clothing, outside of oil-skins and garments made of oil-coated fabrics. The size of this work necessarily limits the treatment of the art of *coating* fabrics. Although a coating of some kind is the only means of making Heavy Cottons genuinely waterproof, the large bulk of the fabrics included under that heading are not coated, but merely strongly impregnated by water-resisting processes. The processes described as for Heavy Cottons will therefore be found to be mainly water-resisting impregnations in which mildew resistance is if anything more important to the manufacturer than water-resistance. Those described under Clothing will be all water-resisting.

CHAPTER 5.

Processes for Heavy Cotton Goods.

Table 1 shows a complete analysis of the main processes in use in America, Great Britain and France on heavy cotton ducks for the purpose of providing water and mildew (rot) resistance on tarpaulins, wagon covers and similar covers used for protecting goods and machinery from the weather. Table 2 describes briefly the processes which stood up best under the United States Government tests for water and mildew resistance. In each case the machinery required is indicated as well as the number of operations and the cost. The last column shows the behavior of the treated duck towards the sewing operations necessary in making covers and in trimming the edges of tarpaulins.

In the following pages some of the more important formulæ and processes are given in detail.

Coating Processes.

English Black Oil Coating.

The goods are given one impregnation in a bath and three coats are brushed on by hand, the following formula being used throughout:

Double boiled baltic linseed oil.....	40 gal.
Vegetable black (very light).......	94 lbs.

The oil is prepared as follows:

TABLE I.

ANALYSIS OF PROCESSES IN USE ON HEAVY COTTON GOODS.

Water- and Mildew-resistant Processes	*A* Processes that do not change color of cloth.	a. Aluminum Acetate Processes.	1. Aluminum Acetate followed by wax solution or wax spray.
			2. Emulsion of Aluminum Acetate, soap and wax.
		b. Paraffin Wax Processes.	
	B Processes that change both color and appearance of cloth.	a. Processes where cloth is impregnated with Bitumens, waxes, etc.	1. Asphaltic Base Impregnation.
			2. Drying Oil Impregnation.
			3. Tar Impregnation.
		b. Copper Processes.	1. Cuprammonium.
			2. Copper Formate.
		c. Coating processes to close pores completely.	1. Coat with a Drying Oil.
			2. Coat with Rubber Compounds.
			3. Coat with pyroxylin compounds.
		d. Cutch and other natural dye combinations.	1. Dye, with mineral after-treatment.
			2. Dye, with after-treatment of soap and waxes.

TABLE 2.

PROCESSES WHICH SHOWED SATISFACTORY RESISTANCE TO BOTH WATER AND MILDEW UNDER UNITED STATES GOVERNMENT TEST.

Character of Process	*Machinery*	*Number of Operations*	*Cost per Square Yard on No. 6 Duck Year 1918*	*Action on Sewing*
Coating with mixture of Asphalts, Bitumen, Paraffin, Pigments and dyes	Coating Mill	2	9¢	Fair
Impregnation with solution of Barber Asphalt, Paraffin wax, Oil and Creosote in Naphtha	Mandrel: Drying Cells	Continuous	8¢	Fair
Coating with emulsion of Bitumens, Mineral Waxes, Greases and Preservatives	Coating Mill	Not Known	Not Known	Very Good
Impregnation first with Aluminum acetate 5° Be. then with Soap and Wax solution in Naphtha	Bath: Mandrel	4	11¢	Very Good
Impregnation in Molten bath of Asphalt, Petroleum Pitch and Copper Soap	Bath and knife. Hot Plate	3	5½¢	Fair

Copper Ammonia	Special Dryers and Ammonia-recovering Plant	3	32¢	
Impregnation with solution of Asphalts, Waxes, Creosote and Wood Oil in Naphtha	Bath: Drying Rack	Continuous	8¢	Good
Wood or Cutch Dye followed by impregnation with Paraffin wax, Paraffin Oil, Copper compounds, Starch and Soap	Jig Bath: Drying Cans	3	11¢	Excellent
Impregnation with solution of carefully selected Waxes, Bitumens and Pigment in Naphtha Solvent	Hand or Bath	2	20¢ by hand 9¢ on machine	Fair
Pressing into cloth mixture of jellied Drying Oils and Pigments	Calender	3	20¢	Good
Cutch dyed and dried chromate and Aluminum Acetate and 16% Soft Paraffin Wax	Dye bath Mandrel	4	12½¢	Good

For every 100 gallons of the baltic linseed oil, use 7½ lbs. of red lead. Heat in an iron kettle over a coke or gas fire to about 555° F. and maintain at that temperature for one to two hours depending on the grade and character of the oil. In some cases where a quicker drying is desired about 2 lbs. of cobalt linoleate is also added.

The application is in the following order:

1. The gray duck is run through the impregnation bath and squeeze rollers.
2. The impregnated duck is hung up in a room open to the air. Artificial high temperatures would give surface drying and must not be used. The drying requires from one to four days depending on the oil, the temperature and the humidity of the atmosphere.
3. The goods are cut up into the sizes desired.
4. Each length is pulled across a table forty feet long and four feet wide and the mixture brushed on by men standing on both sides of the table. The lengths are then hung up to dry.
5. The same as (4) but on the back of the goods.
6. An extra coat the same as (4) and (5) is applied to the face of the goods.

The total weight added to the square yard by this process is about one and one-half pounds. This process cannot be hurried. Speeding up the drying would result in crackiness and increase the liability to spontaneous combustion. Applied to a flax duck, it forms the high-grade covers used in Great Britain for railroad cars and commercial trucks. The results are *genuinely* waterproof.

French Tarpaulins.

The lengths of duck are suspended vertically over a large trough and a soft boiling hot creosote tar run on to them through a hose. The tar is brushed in with large brushes and the paulins are spread on the ground in the open air and left for several days to oxidize. They are finally sprinkled and brushed with fine sand, after which they are ready for use. The appearance of these paulins is very crude, but the French Army authorities claim that they have good wearing qualities and long life.

American Oil Coating.

This is applied by machinery and, therefore, costs much less than either the English or the French. A good formula is:

Boiled linseed oil..................	50 lbs.
Carbon black	10 lbs.
Turkey red oil.....................	10 lbs.
Water	5 lbs.
Ammonia	1 lb.
Petroleum solvent	24 lbs.

The ingredients are agitated to form a thick emulsion which is applied in four coats on a coating mill—two coats on each side of the duck. The coating mill consists of a roller covered with wire carding which pulls the fabric under a steel doctor knife, behind which the emulsion is poured. After leaving the knife the fabric is guided on to an automatic hanging rack which festoons it in a long room heated and ventilated to dry and oxidize the coating.

The three processes above described are real waterproofing processes which close all the pores of the cloth.

The following are heavy water-resisting processes that impregnate the fibers and partially close the pores.

Impregnation Processes.

Asphaltic Base—Molten State.

This is the most economical way of heavily impregnating, as no solvents have to be used. It is also a thoroughly good asphalt base process and has been highly recommended.

The following materials are melted together in a kettle over a gas fire:

Gilsonite	40 lbs.
Pitch	30 lbs.
Scale wax M. P. 110.............	15 lbs.
Paraffin oil	5 lbs.
Creosote oil	5 lbs.
Copper linoleate	5 lbs.
Ingredients for each.............	100 lbs.

The molten mass is run into a spreading machine consisting of a heated tank holding 300 gallons, kept at a temperature of 250 to 300° F. by gas burners underneath, in which a steel drum revolves with about one-fifth of its periphery above the level of the liquid. Against the periphery of the drum revolves a spreading roller which applies the molten liquid to the fabric stretched against it, the excess being scraped off by a doctor knife. The fabric is passed twice over the spreading roller—once on each side—at a speed of 55 yards to the minute, being folded on to a truck after each passage. After the two coats, the goods are pulled over

a semi-circular plate heated underneath with gas flames to cause the compound to penetrate into the fibers of the cloth. This machine is a hollow half cylinder about 5 feet high, 12 feet long and 65 inches wide. The surface on which the cloth is run is heated to 400 to 500° F. by two large gas burners, the excess heat going up a ventilating stack. The goods run at a speed of 25 yards per minute, the contact with the plate lasting about 20 seconds. The goods leave the machine at about 225° F. and their temperature is about 140° F. when folded on the receiving truck.

Asphaltic Base—Solutions.

The following formulæ have been applied with success and for a cheap grade of treatment are recommended. They are applied on a mangle, the goods being squeezed between rollers at a pressure which leaves solution in the cloth to the extent of about 50 per cent of the weight of the cloth. The asphalt or pitch must be free from clay (or any colloids) to produce the best water-resistance. The best kinds of asphalt are Bermudez and Gilsonite; but the residues from asphaltic petroleum crudes were largely used during the World War and gave excellent results. Stearine pitch is the residue obtained in the distillation of cotton-seed oil. The addition of copper oleate increases the mildew resistance, but, except for ducks intended for ground sheets, the formulæ give a fair degree of mildew resistance.

The following gives a nice olive drab shade and a soft finish very *suitable for sewing.*

Bermudez asphalt	210 lbs.
Paraffin wax M. P. 130...........	90 lbs.
Spindle oil	90 lbs.
Naphtha solvent	400 lbs.

A good olive drab color and a high degree of mildew resistance are obtained by the following. The castor oil is used for the sake of producing a *soft finish*.

Stearine pitch (non-saponifiable)...	100 lbs.
Beeswax	30 lbs.
Copper oleate	15 lbs.
Castor oil	25 lbs.
Naphtha solvent	50 lbs.

A somewhat cheaper formula producing a good brown shade:

Gilsonite	100 lbs.
Yellow scale wax................	42 lbs.
Spindle oil	15 lbs.
Naphtha solvent	180 lbs.

The following formula was largely used on cotton duck purchased by the American Army for paulins during the early months of America's participation in the World War.

Trinidad asphaltum	50 lbs.
Neutral wood tar................	200 lbs.
Paraffin wax	100 lbs.
Naphtha solvent	500 lbs.

The gray duck was run through this bath, squeezed between rollers and dried in an automatic hanging drier.

The American Army's own formula applied to paulins by hand with sprinkling cans and stiff brushes:

Neutral wood tar................	300 lbs.
Paraffin wax	100 lbs.
Dried green pigment.............	25 lbs.
Naphtha or other available solvent..	350 lbs.

The tar and wax were melted together in a large cauldron and the solvent added. Wood tar is the residue left in the stills in preparing wood alcohol.

Neither of these formulæ were sufficiently mildew resistant, but in practice, the resistance to water was satisfactory.

There are many variations of these formulæ on the market, many of which are decidedly deficient in both water and mildew resistance. It is most desirable that the waterproofers coöperate with a view to adopting a standard asphaltum base treatment of proved resistance to water and mildew. The following points should be carefully observed:

1. The composition applied must be chemically neutral and free from any acid which could tend to weaken the fabric.
2. The threads of the fabric must be thoroughly saturated with the compound.
3. The compound must not be in the least soluble in water.
4. The process should not stiffen the cloth, but rather have a softening effect to assist the subsequent sewing operations.
5. All solvents should be completely evaporated in order to avoid an unpleasant odor.
6. Drying oils, linoleates, or other materials liable to cause spontaneous combustion, must not be used.

Aluminum Acetate Process.

This is very largely used in France and requires a great deal of labor to secure satisfactory results without any additional treatment. The dyed fabric, either cotton or flax, is run through a bath of basic aluminum acetate solution and rolled up wet without squeezing.

This operation is repeated four times, the fabric being cuttled flat on a cloth truck after the fourth immersion and there allowed to drain off. The goods are then dried by hanging in festoons in a chamber provided with a gentle steam heat. During drying, direct exposure to sunlight should be avoided and high temperature should only be applied after the water has evaporated.

The bath is prepared by mixing the following two solutions and allowing the precipitate of lead sulphate to settle down, the clear solution being applied to the cloth:

Aluminum sulphate	45 kilograms
Water	500 litres

Lead acetate (brown).......	70 kilograms
Water	500 litres

The precipitated sludge should not be thrown away. It can either be run into lead acetate barrels and allowed to dry out hard or it can be run through a filter press to recover the solution which it contains. The resulting cake in either case can be sold to lead smelters or to paint manufacturers.

The quantities vary with the chemical concentration of the materials, but a very good guide as to the right proportion is the film produced by evaporating a sample of the finished solution in a watch glass. The film should be transparent and somewhat tough. If it is chalky and very brittle then too much aluminum sulphate has been used. For treating finer goods use an iron-free aluminum sulphate and a white lead acetate in the proportion of 55 parts of aluminum sulphate to each 100 parts of lead acetate.

Copper Processes.

Under this heading, the two processes specially devised to load the fabric with copper salts are described. They are primarily intended for mildew resistance, but their water resistance is considerable. They are the only processes, apart from oil coatings and the one described in Chapter 9, which render the cotton or flax mildew-proof under all conditions of use.

Copper Aluminum Formate Process.

This is an English process which the British Government tests during the war showed to be as good as the copper-ammonia process and to give better wearing results. It has the advantage over the latter of being applied on ordinary dye-house machinery and not needing any ammonia-recovery apparatus. It is devised to add six to eight grains of copper to the square foot of cloth.

Three standard solutions are used and made up as follows:

A—Copper Formate.

Copper sulphate	64 lbs.
Soda crystals	71 lbs.
Formic acid	28 lbs.
Water (as required).......	200 to 500 gal.

The copper sulphate and soda are dissolved separately and mixed. The precipitate is allowed to settle and the clear liquid is drawn off. The precipitate is dissolved in the formic acid and diluted with water according to the quantity of copper desired per square foot of the cloth.

B—Aluminum Formate.

Aluminum sulphate	66 lbs.
Soda crystals	88 lbs.
Formic acid	40 lbs.

Precipitate the alumina with the soda and dissolve the precipitate in the formic acid. Dilute with water to a gravity of 2° Tw.

C—Waxing Emulsion.

Paraffin wax	22 lbs.
Corn starch	6 lbs.
Soap (castile or naphtha)..........	3 lbs.
Water	As required

These ingredients are boiled together with agitation to form an emulsion.

The following is the application in the dye house for 8 grains copper per square yard of paulin duck, the goods being taken after dyeing.

1. Impregnation thoroughly with a mixture of A and B as follows:

44 gals. *A* (200 gals. strength)
4 gals. *B* (2° Tw.)

2. Dry over steam cans.
3. Impregnate with:

1 gal. ammonia 0.829 spec. grav.
8 gals. water

4. Dry thoroughly over 36 steam cans in a box provided with an exhaust fan to take away the ammonia fumes.

5. Run through a steam-heated bath of *C* provided with steam-heated rollers.

6. Dry over the steam cans.

A solution of wax in naphtha, if practicable, can be substituted for bath *C* with advantage. An asphaltic base can then be added as a substitute for the preliminary dyeing operation. This coloring effect can also be obtained by using the following emulsion instead of *C*.

Neutral tar	100 lbs.
Paraffin wax	25 lbs.
Paraffin grease	15 lbs.
Corn starch or glue..............	20 lbs.
Soap (castile or naphtha).........	15 lbs.
Water	75 gals.

The Cuprammonium Process.

This consists in passing the cotton goods through a solution of copper or copper hydrate in ammonia and then, after squeezing out the excess of liquid, subjecting the fabric to very hot air. The solution dissolves some of the cellulose of the fiber and, on drying, a film is left on the fiber having a characteristic blue-green color and a considerable gloss.

The process has been in use in England and Austria for forty years or more and was introduced to this country about the year 1916. The mildew resistance is high and water resistance good, but the great objections to this process are its high cost and the fact that prolonged exposure to sunlight bleaches and disintegrates the film, thus destroying the water resistance.

The solution can be made by allowing ammonia of 0.91 specific gravity to trickle over copper turnings. It can also be prepared by precipitating copper sulphate with caustic soda, washing the precipitate very thoroughly and

dissolving it in ammonia, using about 1 lb. of ammonia to every ounce of copper sulphate. In either case, a copper strength of from 1½ to 2 per cent is desirable.

Figure 4 shows two cross sections, A and B, of the plant used in Austria, where a particularly fine finish is obtained.

The goods pass through impregnating tank (*a*) and squeeze rolls (*b*) which are no different from those found in most dye houses. From (*b*) they go into the drying chamber (*c*) with its arrangements of fire-heated flues and carrying-rollers for the passage of the goods, which are drawn out of the drying chamber and folded at (*d*). The drying chamber is provided at (*e*) with shutters with which the temperature and air supply can be regulated and through which the ammonia driven off the fabric escapes.

In the modern plants in America and England, steam coils are substituted for the direct fire flues and an ammonia recovery plant is added. To obtain uniform and best results a very close chemical and physical control of the process is necessary.

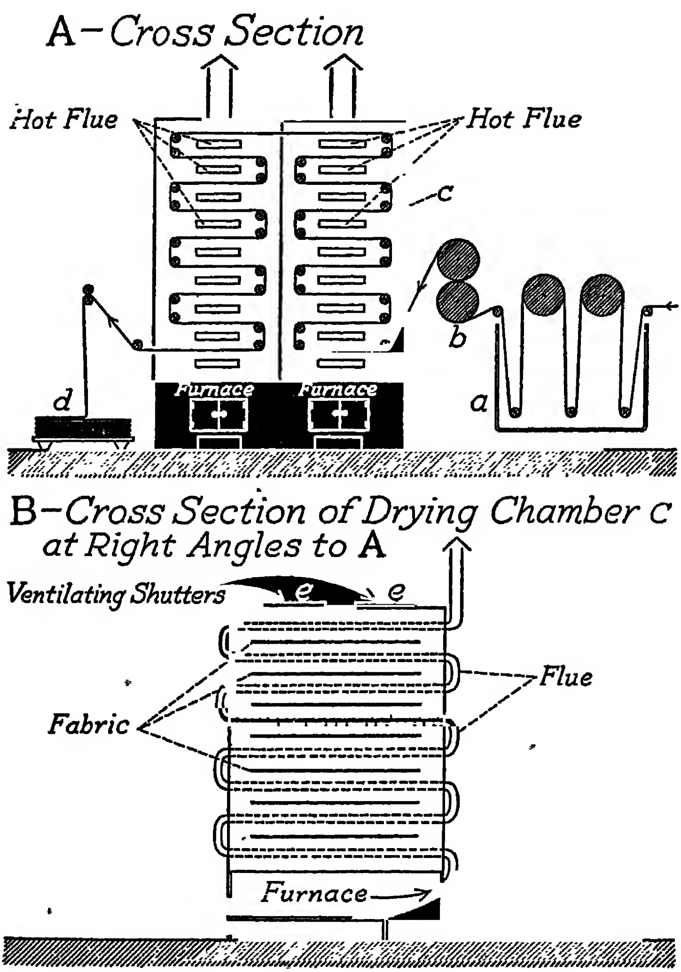
A–Cross Section
Hot Flue
Hot Flue
c
b
d
Furnace
Furnace
a
B–Cross Section of Drying Chamber c at Right Angles to A
Ventilating Shutters
e
e
Flue
Fabric
Furnace

FIG. 4.

CHAPTER 6.

Processes for Clothing Fabrics.

The processes used for "showerproofing" the woolens, silks and lightweight cottons used in making clothing as at present universally practised, consist, for the most part, in different methods of applying small quantities of paraffin wax to the fabric in such a manner that it is evenly distributed and invisible to the naked eye. The addition of scale wax or vaseline to soften the wax is often resorted to and other substances are added for special purposes, such as, for instance, the procuring of the permanent invisibility of the treatment on silk goods. A preparatory treatment with a weak aluminum acetate bath is used by some concerns to reinforce the water resistance and make it more permanent.

A refined paraffin wax with a melting point of about 135° F. is generally used, either without addition or with a softening wax, oil or grease. The wax is applied to the cloth by one of four methods:

1. Spreading a solution in gasoline or naphtha.
2. Rubbing the fabric against the solid wax.
3. Spraying the molten wax.
4. Impregnating with an emulsion.

(1) Spreading.

The spreading method is used universally for silks, pure paraffin wax, often softened with vaseline or heavy mineral oil, being employed. The wax compound is

melted and run into deodorized gasoline—about 4 to 7 volumes of wax to 100 of solvent. Benzol is used in place of gasoline ("benzine") and sometimes carbon tetrachloride is mixed liberally with either of these solvents to procure uninflammability. The solution is poured into a trough in which an idler roller is half immersed. The fabric is passed over this roller at a tension, absorbing the solution as it revolves the roller, and then goes on to drying cylinders, a drying frame, or an automatic hanging machine in a space well heated with steam pipes and provided with an exhaust ventilating system.

(2) Rubbing.

The rubbing method is commonly used for woolens and light cottons. The paraffin wax is softened by additions of scale wax or vaseline and cast into huge bars slightly wider than the width of the cloth and three to four inches thick. The bar is held in a frame which supports it in a vertical position. The cloth passes over a steam box and then at a variable tension under the bar where it rubs off a small quantity of the wax more or less evenly and passes on to a steam calender which melts the wax and "irons" it in.

The best form of this machine is one in use in Boston, which consists of a drum supporting five frames each holding a wax bar. This drum is revolved at a fair speed and the goods are drawn over the bars at a tension which can be regulated. This arrangement gives a more even distribution than can be attained by the use of a single bar.

(3) Spraying.

The spraying machine consists of a row of small vertical pipes immersed in a tank of molten wax, the mouth

of each pipe being adjusted against a small steam nozzle. High-pressure steam causes a spray of molten wax, be-

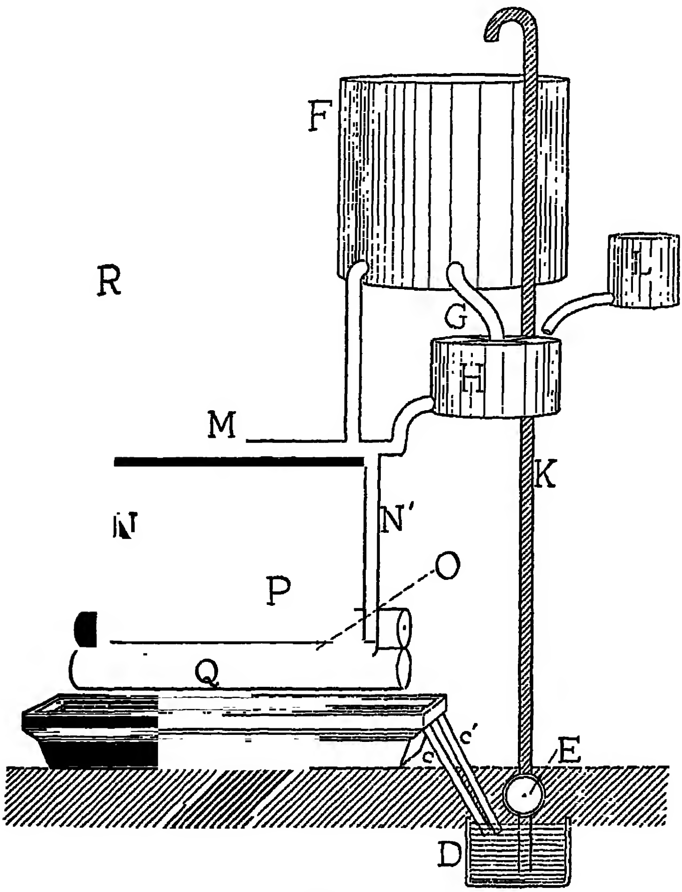

FIG. 5.

fore which the cloth is drawn. The sprays are enclosed in a large box exhausted by a fan. From the spraying box the goods pass on to drying cylinders where the solid

powder deposited when the spray strikes the cloth, is melted into the fibers.

(4) Emulsion.

The emulsion method of applying paraffin wax has been described in the chapter on Heavy Cotton Processes. Variations of it are used to some extent in "showerproofing" fine fabrics, but the emulsion is not good enough to give the even distribution of the wax which is necessary on such goods and this method is not to be recommended unless applied with the aid of special machinery.

The writer has seen a machine in operation on fine woolen goods which successfully applied an emulsion of plain paraffin wax and hot water. A front-view sketch of this installation is seen in Figure 5, while the sectional drawing in Figure 6 shows the run of the goods and the arrangement of the trough.

A is the trough of an ordinary padding machine provided with gutters B, B′ running the length of the trough on each side. These take the overflow from trough A and are connected by pipes C, C′ with a small tank D which is exhausted by a rotary pump E raising the emulsion to a circular tank F provided with an agitator and steam coils. A pipe G leads from the tank F to a centrifugal mixer H into which also runs a pipe leading molten wax from a heated tank L. Both pipes leading into the mixer H are provided with stop cocks to regulate the flow of emulsion and wax respectively into the mixer. Pipes M, N and N′ lead the emulsion from the mixer H to a spray pipe O arranged to spray the emulsion right into the nip of the squeeze rollers P and Q. An air pipe R is connected to the end of pipe M.

The goods are threaded in the machine as indicated by the dotted line in the cross section shown in Figure 6. The tank F is filled with water, which is heated by the

steam coils to nearly boiling point. The mixer H is started and the cocks in pipes G and K opened to the extent dictated by experience. As soon as the spray O is flowing freely, the rollers P and Q are started, the pipe from the tank L supplying the wax to the emulsion as it

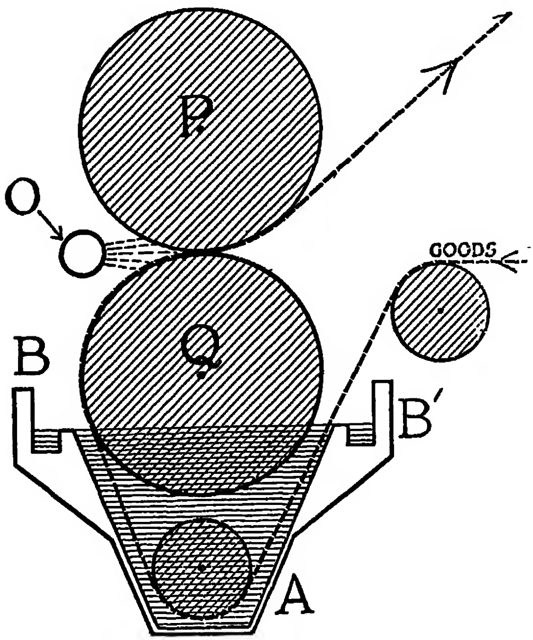

Fig. 6.

is taken up by the goods, which are batched on a roller working on roller P. The quantity of wax applied to the goods is regulated to a nicety by the cock in the pipe leading from the tank L containing the molten wax. By keeping the tank F at a temperature of about 180° F., the machine applies the wax quite evenly to the cloth, which is afterwards dried on a cylinder drying machine.

Sundry Processes.

An Emulsion Process for Woolens.

The following is an emulsion formula for woolens which produces not only perfectly even results but also a beautifully soft finish. The substitution of Japan wax for paraffin results in an emulsion which does not separate out in the slightest during application to the cloth and can be kept in emulsion indefinitely in a moderately warm state. *This formula can, however, only be applied on woolens that are dyed perfectly fast to alkali.*

Water	25 gals.
Pure tallow soap..................	5 lbs.
Sodium silicate (water glass).......	4 lbs.
Sodium aluminate	5 lbs.
Japan wax (molten)..............	4½ lbs.

Boil the water and add the ingredients in the above order with stirring, boiling all the time. Finally, make up to 40 gallons with water and keep hot.

To treat 1,000 yards of six-quarter woolen piece goods, add 15 gallons of the above mixture to 40 gallons of water in a padding machine geared to run 70 yards to the minute, bringing the temperature to 100° F. and maintaining it there. Run the goods once. Then add 10 gallons of the mixture and run twice. Add 5 gallons and run twice more. Let the goods lie in fold for a few hours and run six times through a padding machine geared to 120 yards to the minute and charged with a strong solution of aluminum sulphate. Finally wash off in another padding machine, one run hot and one run cold water.

This is an expensive process to run and is only appli-

cable to the more expensive fast dyed goods; but it gives a better finish and a finer water-resistance than anything the writer has seen on woolens.

The Soap and Alum Process.

Sometime about one hundred years ago when it was invariably the custom to produce honest-to-goodness waterproofing by coating or filling the fabric, a dyer was given a soap-scoured but imperfectly rinsed piece of woolen to dye with a dyestuff requiring an alum mordant. After the alum bath the goods had to be dried to wait a few days for a dye bath. On trying to dye the goods, the dyer found that his dye would not "take" properly, but that the fabric had a considerable resistance to the absorption of water. Thus started the first water-resistant treatment and variations of the soap and alum process have been in constant use to this day.

By this process, the fibers are impregnated more or less thoroughly with a mixture of aluminum stearate, aluminum oleate and potassium sulphate. In spite of the fact that the presence of soluble potassium sulphate in the fiber reduces the water-resisting effect, it is only comparatively recently that sulphate of alumina was substituted for potash alum, thus eliminating the soluble salt.

In recent years a revival of this ancient process secured the backing of Wall Street financers with the aid of the ancient, but, to the uninitiated, startling demonstration made by pouring water gently on to a piece of cotton mosquito netting without any of it running through the holes in the fabric. The inventor had a wonderful theory of osmotic pressure and an elaborate apparatus consisting of aluminum rollers and carbon plates consuming enormous quantities of electric current as anode and kathode. The process is in effect a precipitation of aluminum

acetate by soap which could be produced more effectively and much more cheaply with a series of heavy squeeze rollers. This process has been advertised as an "electric" process suitable for woolen fabrics; but it has never made any headway because of the fact that in order to obtain adequate water resistance, it is necessary so to load the fabric as to interfere with the finish and tailoring properties of the cloth.

The mosquito netting demonstration is frequently employed in promoting so-called "waterproofing" processes. The reader can produce it for himself by dissolving one part by volume of molten paraffin wax in twenty parts of gasoline, soaking the netting in the solution and evaporating off the solvent. The chances are that the resulting test will be more striking than that demonstrated to him.

CHAPTER 7.

Formulæ for the Farmer.

Amongst the numerous "waterproofing" and "mildew-proofing" preparations offered to the farmer and ranch-owner only one or two really have merit in the direction of materially increasing the efficiency and wearing quality of the cotton ducks they use for awnings, wagon covers and tents.

The Leather and Paper Laboratory of the United States Department of Agriculture in Farmers' Bulletin 1157 give some practical formulæ and a method of application which have been given a very thorough series of tests.

Ducks so treated will be found to resist wetting very materially and though they cannot be said to be mildew-proof in the strict sense of the word—and the farmer should take care not to fold them when wet—yet their mildew resistance is sufficient to increase their life. Formulæ Nos. 1, 3 and 4 will undoubtedly double the life of the duck and No. 2 should treble it.

Formula 1.

	Lbs.
Amorphous mineral wax or crude petrolatum.....	7½
Yellow beeswax	1
Refined Bermudez Lake asphalt.................	1½

Solvent: 3 gals. gasoline and 2 gals. kerosene.

FORMULA 2.

	Lbs.
Petroleum asphalt (medium hard) or Bermudez asphalt	6
Neutral or extracted wool grease	2½
Lead oleate, technical	1½

Solvent: 3 gals. gasoline and 2 gals. kerosene.

FORMULA 3.

	Lbs.
Amorphous mineral wax or crude petrolatum	8½
Yellow beeswax	1½

Solvent: 3 gals. gasoline and 2 gals. kerosene.

FORMULA 4.

	Lbs.
Amorphous mineral wax or crude petrolatum	6½
Yellow beeswax	1½
Lead oleate, technical	2

Solvent: 3 gals. gasoline and 2 gals. kerosene.

Applications of mixtures made by Formulas 1 and 2 give the canvas a dark brownish color, while those made according to Formulas 3 and 4 give it a light buff to khaki color. The first two are preferable for all purposes where a dark color is not objectionable.

The amorphous wax referred to in the formulas is a soft grease-like mineral "wax" obtained as a by-product in refining chilled cylinder-oil stocks by means of centrifugal machines, and is very similar to dark petrolatum, except that it is more viscous and has a higher melting point. The substitution for it of dark or amber petrolatum will not materially change the results. Lead oleate is an insoluble metallic soap, which is added to improve

water-resistance as well as mildew-proof. The kerosene is added not only to decrease the cost, but to reduce the volatility of the solvent, thus making the mixture spread better. All of these materials may be purchased, but not always from local dealers. Amorphous mineral wax or crude petrolatum (sometimes called petroleum grease) may be secured from dealers in oils and greases. The asphalts are obtainable from dealers in roofing materials. At present it probably is impossible to buy the wool grease from local dealers. This material, as well as amorphous mineral wax, however, may be ordered from wholesale dealers in oils and greases or tanners' supplies, through hardware stores, or through dealers in agricultural supplies and implements. Lead oleate, which also is not sold by small dealers, must be ordered from manufacturers of chemicals through local druggists or paint dealers, who will also supply beeswax.

Mixing the Materials.

Weigh out the solid materials in proper proportions, place them in a kettle or can, and melt slowly and carefully at as low a temperature as possible, with constant stirring. When the mixture has completely melted, remove to a safe distance from the fire, and pour it slowly, with constant stirring, into the proper quantity of solvent (a mixture of 3 parts by volume of gasoline and 2 parts by volume of kerosene), using 5 gallons of this solvent to 10 pounds of the mixture. This should be done with free ventilation, preferably out of doors.

In the preparation of mixtures by Formulas 1 and 2 there is sometimes a separation of asphalt that does not mix uniformly with the solution upon stirring or shaking. In such cases allow the mixture to stand a day or so, with occasional stirring, before applying it to the

FIG. 7.

canvas. In other cases where the material settles to the bottom of the container or thickens, it will be necessary to warm the mixture just before applying it to the canvas. This must be done in the open air by placing the open container in a tub or can of hot water. Be sure that the container is open, and *never place it over or near a flame.*

Application.

The mixture must be thoroughly stirred before and during application, in order to keep the undissolved material in suspension. These preparations may be applied to the canvas by means of a paint brush or by spraying. One method is shown in Figure 7. Wagon covers, shock covers, etc., may be treated best by stretching the canvas against the side of a barn or attaching it to a frame and applying the material with a brush, as shown in Figure 7. Once the canvas is fixed in position, no more time is required to treat it than is necessary to apply a first coat of paint to a rough board siding having the same area. Much time may be saved in treating large paulins and standing tents by applying the material with a spray pump, with which a pressure of at least 50 pounds is developed. Some loss of material, however, results from this method.

The experience of the Department has been that one coat applied to one side of the canvas is usually sufficient. When one coat is applied to one side, using the strength of solution as given in the formulas, there will be an increase in weight of from 3½ to 4½ ounces per square yard. Ten pounds of the material and 5 gallons of the solvent will treat about 40 square yards of canvas.

CHAPTER 8.

Testing Water Resistance.

Many and varied are the tests which have been devised for estimating the extent of water resistance applied to fabrics by the various waterproofing concerns. None have been so strange as that applied by a certain clothier who proved that a certain water-resistant treatment applied to woolen coating was less waterproof than the untreated cloth. He piled the treated and untreated goods respectively in two piles with possibly fifty layers of cloth in each. At the top of each pile he punched with his fist to form a depression in the cloth, into which he poured a glass of water. Then he took a large wooden mallet and brought it down with all his force on the top of the water lying on the top of the pile. This heroic treatment was followed by an inspection of the layers of cloth to find out how many layers down the water had penetrated. He found that the penetration went twice as far in the case of the treated goods. The reason was, of course, that the power of absorption of the treated fibers was much reduced, permitting the water to be forced through more layers until it was all absorbed, whereas the same quantity of water was absorbed much sooner by the top layers of the treated cloth.

Not quite so foolish, but equally illogical, tests both on clothing and on heavy cottons have been proposed from time to time and no effort was made to compare and standardize all the proposed tests until under the exigencies created by the World War, the Leather and Paper

Laboratory of the United States Department of Agriculture turned their attention to the subject. They evolved a modified funnel test and a modified spray test, simple and quick in execution and yielding more information in the water resistance of cotton duck than any of the other existing tests which they tried. Messrs. F. P. Veitch and T. D. Jarrell describe these two tests as follows:

Modified Funnel Test.

Cut a piece of the fabric one foot square, weigh, crumple thoroughly in the hand and place in an 800-cc. beaker and soak in distilled water at from 70 to 80° F. for 24 hours, removing, straightening out and recrumpling 4 or 5 times during this period. Remove from the water, straighten out and dry in oven at 45° C. for 24 hours. Hang in laboratory over night. Crumple, resoak in distilled water, and dry at 45° C. for 24 hours and hang in laboratory over night as before. Again crumple, smooth out and place on a piece of absorbent paper (paper toweling) of the same size and fold the two together into the form of a filter, insert in a 6-inch glass funnel having an angle of 60°, and place the funnel in a support over a 500-cc. graduated glass cylinder and fill the funnel to a depth of exactly 4 inches with distilled water of 70 to 80° F. This depth equals 500 cc. of water. Maintain a constant water level above the funnel by inverting an Erlenmeyer flask filled with water and closed with a rubber stopper through which passes a glass tube ground at the end to an angle of 45°.

Make the following observations:

1. The time elapsed before the paper begins to wet.
2. The time elapsed until the paper is entirely wet.
3. The time elapsed before the first drop passes into the cylinder.

4. The quantity of water in the cylinder in 1, 3, 6 and 24 hours.
5. The time and extent to which the fabric becomes wet above the water level.

At the expiration of 24 hours, if there has been no dripping, the funnel filled with water is lifted 2 inches and allowed to drop into its support; this is repeated four times and the amount of water that drips through in 3 hours, if any, is recorded.

Remove the funnel from its support and carefully pour and drain off the water, and then remove the fabric and paper from the funnel, smooth out, and observe:

1. Whether the paper is dry, damp or wet.
2. Whether the fabric on the outside is dry, damp or wet, or whether the water has only sweated through.

The water resistance of fabrics as determined by this method is rated in accordance with the following scale:

Very High 10	The fabric does not become wet above the water level within 24 hours. No water drips through. No sweating through is apparent except to a very limited extent at the folds. Filter paper under the fabric remains dry, except for slight wetting where the fabric is folded.
High 9	The fabric does not wet above the water level within 24 hours. Sweating through is sufficiently rapid to cover generally, and especially in the fold, the outside of the fabric with droplets. Filter paper under the fabric becomes wet.
High-Medium 7 and 8	The water dripping through: In 6 hours is from 1 cc. to 5 cc. In 24 hours is from 1 cc. to 25 cc. In 3 hours after raising and allowing the funnel to drop into support 5 times.

Medium 5 and 6	The water dripping through: In 6 hours is from 5 to 25 cc. In 24 hours is from 25 to 50 cc.
Medium-Low 3 and 4	The water dripping through: In 6 hours is from 25 to 75 cc. In 24 hours is from 50 to 150 cc.
Low 1 and 2	The fabric wets above the water level readily. The water dripping through: In 6 hours is from 75 to 200 cc. In 24 hours is from 150 to 300 cc.
Negligible 0	The water dripping through in 24 hours exceeds 300 cc.

Modified Spray Method.

Dry the piece of fabric used in conducting the funnel test at 45° C. for 24 hours, hang in laboratory over night and clamp loosely in a frame. Set the frame in a holder attached to a trough at an angle of 45°. The trough used held six frames. Allow clear tap water at room temperature to fall from a height of 6 feet upon the central portion of the fabric, covering an area of about 8 inches in circumference, for 24 hours, from a 2¾-inch brass spray nozzle having 25 holes, each 1.0 mm. (0.75 inch) in diameter, at a rate of 1,000 c.c. per min.

Inspect the condition of the under side of the fabric at the end of 5 minutes, ½ hour, 1 hour, 3 hours, 7 hours, and 24 hours. Note at each inspection whether the under surface is dry, damp or wet with no dripping; damp or wet with dripping.

The water resistance of fabrics as determined by the modified spray test is rated on a scale of 10 as follows:

10 Undersurface of fabric remains dry for 24 hours.
9 Undersurface remains dry for 7 hours but is damp or wet in 24 hours. No dripping.

8 Undersurface remains dry for 7 hours but is damp or wet in 24 hours. Dripping.
Undersurface remains dry for 3 hours but is damp or wet in 7 hours. No dripping.
7 Undersurface remains dry for 3 hours but is damp or wet in 7 hours. Dripping.
6 Undersurface remains dry for 1 hour but it damp or wet in 3 hours. No dripping.
5 Undersurface remains dry for 1 hour but is damp or wet in 3 hours. No dripping.
4 Undersurface remains dry for ½ hour but is damp or wet in 1 hour. No dripping.
3 Undersurface remains dry for ½ hour but is damp or wet in 1 hour. Dripping.
2 Undersurface remains dry for 5 minutes but is damp or wet in ½ hour. No dripping.
1 Undersurface remains dry for 5 minutes but is damp or wet in ½ hour. Dripping.
0 Undersurface damp to dripping in 5 minutes.

The ratings given by these two tests were compared with the results obtained by actually exposing corresponding samples to rain, with blotting paper underneath them, with the following results:

TABLE 1.

COMPARISON OF THE FUNNEL AND THE SPRAY TESTS WITH ACTUAL EXPOSURE TO RAIN.

Number	*Funnel Test Rating*	*Spray Test Rating*	*Actual Rain Test (Condition of Blotting Paper)*
32340	0	0	Wet
32745	0	0	Wet
33253	0	0	Wet
33330	0	0	Wet
33433	0	0	Wet
33676	4	2	Wet
33886	0	0	Wet
33965	0	4	Wet

COMPARISON OF THE FUNNEL AND THE SPRAY TESTS WITH ACTUAL EXPOSURE TO RAIN—*Continued*

Number	*Funnel Test Rating*	*Spray Test Rating*	*Actual Rain Test (Condition of Blotting Paper)*
34751	0	0	Wet
34772	0	0	Wet
34780	0	0	Wet
34791	0	0	Wet
34792	0	0	Wet
34964	0	2	Wet
35261	0	0	Wet
35729	0	0	Wet
35730	0	0	Wet
35731	0	0	Wet
35756	0	0	Wet
33617	0	4	Dry
34748	9	9	Dry
34749	10	7	Dry
34810	4	9	Dry
34824	10	9	Dry
34826	4	8	Dry
34828	10	8	Dry
34831	9	9	Dry
34856	0	6	Dry
35737	0	9	Dry

In order to obtain consistent and reliable results by this method, it is necessary to follow closely the directions as outlined, especially as to drying in the oven at 45° C. (113° F.) for 24 hours. Many comparisons have been made on samples of various treatments by (1) soaking and drying in the air in the laboratory for 24 hours and (2) by drying in the oven at 45° C. for 24 hours. The results show a low water resistance on many samples when dried in air only, and a high water resistance when dried in the oven at 45° C. In no case has the reverse been true.

While it is realized that this test as conducted in this

laboratory is a severe one, no canvas which withstands it has been found to fail in actual service.

These laboratory tests made on standard army duck treated by various formulæ were checked up against actual observations on strips of the same duck exposed to rain. The duck was attached in strips 12 feet long and 15 inches wide to a wooden frame as shown in Figure 8 and exposed in the open country for about a year from August, 1919. The frame was set level from end to end, faced the east and was designed to give all possible types of outdoor exposure that are likely to occur in the use of canvas as wagon covers, goods covers, tents, awnings, etc. The paulin was loosely but smoothly stretched on this frame in such a way that 3.5 feet of each treatment were level, and 3.5 feet were inclined at an angle of 30°, while at the bottom of the inclined section the paulin was made to form a bag section about 6 inches deep. Rain falling on the canvas, both on the level and the inclined sections, ran down and collected in the bag section, where it was allowed to remain for some time, often from 2 to 3 days, before emptying. Both in the level and the sloping sections the canvas touched a 2-inch strip of wood and also a board 12 inches wide, while in between these boards the underside was exposed to the air. In this way, it was expected to show the effect of contact with objects on the underside of the canvas, and also the penetrating effect of rain on both the unsupported and the supported canvas. The paulin was tied on the frame but was free to move with the winds, which lifted it, subjecting it to such strains and motion as would occur on a moving load.

From the observations made on the samples exposed to the weather the following conclusions were drawn:

1. Both the funnel and spray tests applied to new,

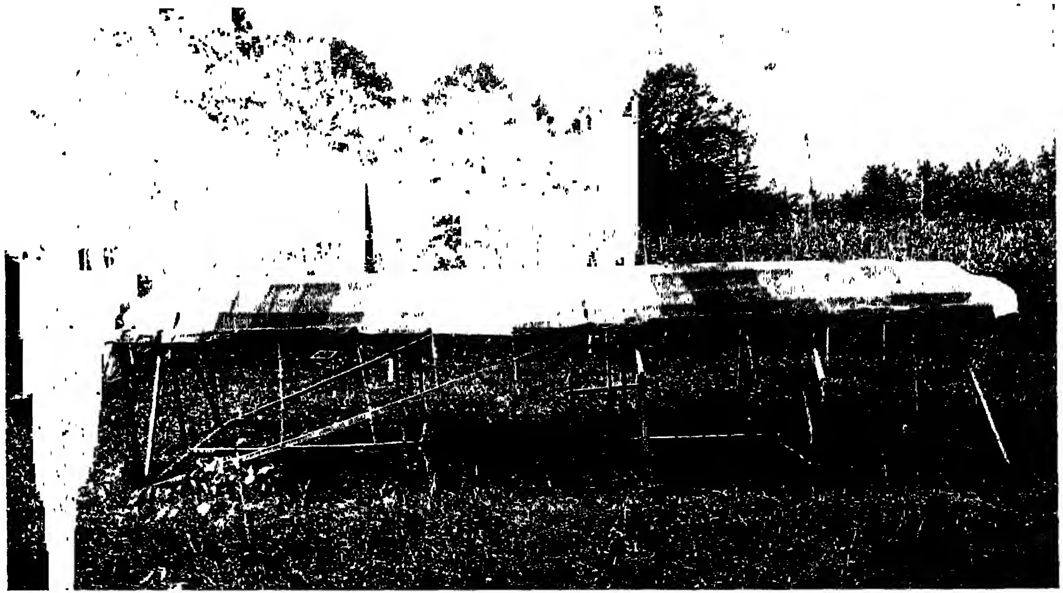

FIG. 8.

treated duck indicate higher water resistance than is actually found in service.

2. Water-resistant treatments for 12-ounce United States standard army duck giving a rating of 6 or better by the spray test have proved serviceable for smooth covers, such as awnings, wagon tops, stack and hay covers.

3. The waterproofing treatments which have proved most serviceable on 12-ounce United States standard army gray duck have also given high results by the funnel test. However, not all treatments showing a high rating by the funnel test have proved highly serviceable in those cases where water lay for some time on the canvas.

4. When a treatment secured the maximum rating by both the funnel and the spray tests, it also received a high rating in the service test.

5. After a year's exposure, the ratings by the funnel test, with a few exceptions were lower than the service ratings.

6. After a year's exposure the ratings by the spray test were still high and were in general harmony with the observations made on the sloping and flat sections of the canvas.

7. In the formulas used, paraffin, Japan wax, ceresin, candelilla wax, and rosin were not effective waterproofing materials on canvas. Although formulas containing these materials may have rated high by both the funnel and the spray tests when the canvas was new, they lacked durability.

8. Neither the funnel test nor the spray test alone is an infallible indication of the serviceability of a waterproofing treatment for canvas.

Effect of Sunlight on Treated Canvas.

Messrs. T. D. Jarrell and H. P. Holman of the Bureau of Chemistry, United States Department of Agriculture

have made the interesting discovery that a year's exposure to sunlight and weather of certain "waterproofed" canvas samples actually causes them to lose more tensile strength than in the case of corresponding untreated canvas. The weakening of both the treated and the untreated is due to the effect of the sun's rays and their experiments have demonstrated that this may be prevented by the addition of pigments to the waterproofing formulæ and that this addition does not interfere with the water resistance. They had previously found in testing a number of yarns treated with different formulæ, that those containing asphalt did not lose strength, whereas those containing little or no coloring matter lost strength materially.

Canvas treated by them with three commercial preparations free from pigments showed marked deterioration in tensile strength after six months' exposure.

The following table of their results will be useful to waterproofers for the purpose of checking up their formulæ:

TENSILE STRENGTH OF COTTON DUCK SUBJECTED TO LABORATORY WATERPROOFING TREATMENTS, WITH AND WITHOUT THE ADDITION OF PIGMENTS, AND EXPOSED TO THE WEATHER FOR SIX MONTHS.

T. D. Jarrell and H. P. Holman.

Treating Materials (*see footnote page* 57)	*Tensile Strength After Exposure (1-in. Warp), Kg.*	*Variation from Strength of Untreated After Exposure, Per Cent*	*Tensile Strength of Unexposed Canvas,† Kg.*
Untreated control, 12 oz., gray, U. S. Standard army duck	38	..	62
Treatment A (Yellow petrolatum and beeswax)	6	—84	55
Treatment A and dry yellow ochre	40	+ 5	62
Treatment A and yellow ochre ground in linseed oil	49	+29	59
Treatment A and dry Indian red	26	—32	..
Treatment A and Indian red ground in linseed oil	31	—18	..
Treatment A and dry Venetian red	31	—18	..
Treatment A and Venetian red ground in linseed oil	37	— 3	..
Treatment A and dry burnt sienna	43	+13	58
Treatment A and burnt sienna ground in linseed oil	39	+ 3	56
Treatment A and dry raw sienna	48	+26	59
Treatment A and raw sienna ground in linseed oil	38	0	59

Tensile Strength Tests.—*Continued*

*Treating Materials**	*Tensile Strength After Exposure (1-In. Warp), Kg.*	*Variation from Strength of Untreated After Exposure Per Cent*	*Tensile Strength of Unexposed Canvas† Kg.*
Treatment A and dry burnt umber	50	+32	59
Treatment A and burnt umber ground in linseed oil	39	+3	55
Treatment A and dry raw umber	43	+13	54
Treatment A and raw umber ground in linseed oil	41	+8	60
Treatment A and dry Prussian blue	35	—8	..
Treatment A and dry dark chrome green	33	—13	..
Treatment A and dry artificial malachite green	39	+3	..
Treatment A and dry red lead	32	—16	..
Treatment A and dry chrome yellow	18	—53	..
Treatment A and dry lampblack	47	+24	..
Treatment A and Bermudez asphalt	21	—45	..
Treatment A and petroleum asphalt	16	—58	..
Treatment A and dry zinc oxide	32	—16	..
Treatment A and dry white lead	20	—47	..
Treatment A and whiting	27	—29	..
Treatment A and barytes	10	—74	..
Treatment A and kaolin	11	—71	..

Treatment A and dry lithopone	11	—71	..
Treatment B (Yellow petrolatum, copper oleate, and petroleum asphalt)	30	—21	58
Treatment B and dry burnt umber	52	+37	59
Treatment C (Yellow petrolatum, beeswax, and petroleum asphalt)	23	—39	59
Treatment C and dry burnt umber	50	+32	57
Treatment D (Boiled linseed oil, commercial)	22	—42	62
Treatment D and dry yellow ochre	40	+ 5	59
Treatment D-1 with Japan drier in turpentine (1 pt. to gal.)	41	+ 8	62
Treatment D-2, applied after brushing sol. of soft soap on canvas	30	—21	55
Treatment D and dry Indian red	37	— 3	58
Treatment D and dry Venetian red	36	— 5	..
Treatment D and dry burnt sienna	36	— 5	..
Treatment D and dry raw sienna	37	— 3	..
Treatment D and dry burnt umber	33	—13	..
Treatment D and dry raw umber	42	+11	..
Treatment D and dry lampblack	54	+42	..
Treatment D and dry zinc oxide	58	+53	..
Treatment D and dry white lead	29	—24	..
Treatment D and dry kaolin	40	+ 5	..
Treatment D and dry aluminium bronzing powder	51	+34	..
Treatment D and dry flake graphite	41	+ 8	..
Treatment D and dry Prussian blue	39	+ 3	..

* Where pigment was used, it was added to the waterproofing mixture at the rate of 1 lb. per gal. in every case, except A-15, in which pigment at the rate of 0.5 lb. per gal. was used.

† Tests made on portions of treated canvas kept in the laboratory, well protected from light, for the same length of time as the other portions were exposed. Tests not made on all samples because representative treatments showed little deterioration.

CHAPTER 9.

New Developments.

There have been surprisingly few developments in the art that can really be called new either during or since the World War. Most changes have been in the direction of new ways of applying old materials and others have not reached a sufficient degree of practical use to warrant presentation in this work. The only really basic development, involving the use of entirely new materials, that has taken place in recent years is one introduced and thoroughly demonstrated on many thousands of yards of cotton goods by a well-known authority in the cotton duck trade of New York City.

The process consists in precipitating in the fiber the insoluble salts of a base derived from the treatment of a plentifully occurring mineral substance. The insoluble salts are deposited in a finely divided state in the fibers of the cotton cloth by ordinary dye-house impregnation methods. The resulting cloth if properly treated is not changed in appearance and possesses a high degree of water-resistance, while it has not, so far, been found possible to mildew it. The cost of preparing the materials is slight and there is nothing expensive about the impregnation method of applying them.

The remarkable thing about the process, however, is that once the precipitate is fixed in the fiber, neither repeated boilings in soap and water or soda, nor repeated soaking in hot gasoline or even alcohol removes it or affects it.

No one hitherto has ever produced on a practical scale a water-resistant finish on cotton or any other textiles which will maintain its water resistance against the laundering and dry cleaning processes, though some effort has been given to research work with that object in view.

So far, this new process, which is protected by a basic patent application, has only been developed on a practical scale in connection with cotton goods. Laboratory experiments indicate, however, that it will ultimately be applicable to wool and silk.

In Chapter 3 the defect of existing processes as regards dry cleaning was mentioned and the desirability of scientific research and coöperative endeavor was urged. That chapter was written before the new development under consideration came to the attention of the writer. Should this new process develop as well on wool and silk as it has on cotton goods, it will simplify the technical development necessary as the background of any coöperative effort to give the public the protection it ought to have for its clothing. As long as the only available processes put into the fabric a substance which the dry cleaners' solvent removes, so long will the proper development of the idea have to comprise the education and organization of the dry cleaners of the country—a difficult task of no mean dimensions.

With a process which the dry cleaner can do nothing but improve by his operation of removing accumulated dirt from the garments, the way is opened for a big organization to coördinate the activities of fabric manufacturer, dyer, finisher, waterproofer and garment manufacturer to produce outer garments for men, women and children which are not soiled by absorption of water or watery liquids conveyed by casual splash, spill or shower. Under present conditions nearly all the clothing we wear that is subjected to the elements, or liable to casual contact with

water out of place, is damaged to some extent thereby. As there would be less of such garments sold if they kept their smartness longer, it is not likely that any of the individual trades concerned will take the initiative in giving the consumer the value to which he is entitled and would undoubtedly be willing to pay for.

The respect for "repeat business" is so great in modern industry that the interests of the consumer are often entirely neglected. Awnings would last much longer if they were given a protective water- and mildew-resisting treatment and such treatments are available at a cost which the user of awnings would gladly pay; but the suppliers of awnings would thereby lose a great deal of "repeat business." It is not likely that any one awning supplier will launch out and supply lasting awnings, because he would have to ask a higher price than his competitors and he could not keep up his business without an enormous advertising appropriation for the purpose of educating awning users.

A similar condition exists in the garment industry and would hamper any effort of an individual cloth or clothing manufacturer. Any effort in the textile industry to introduce universal protection for clothing and other articles must rest for its success on the education of the public to the value of the protection, to its cost to them and to the saving it will bring them. This effort should only be undertaken after research work adequate to establish effective processes, economically applicable to all kinds of textiles. The next step is the placing of the processes with a large number of fabric manufacturers and dyers all over the country, the connecting of it with a trade-mark and last, and most important, the extensive advertising of the trade-mark to the public, the retailers and the manufacturers of garments and other articles. Such a plan needs several hundred thousand dollars for

research, organization and advertising; but to the firm or the individual who can secure the necessary financial backing to effect a coördination of adequate effort in this direction, from raw materials to consumers' backs and to educate the public to its value, a pioneer's fortune is waiting.

CHAPTER 10.

BIBLIOGRAPHY OF PROCESSES AND FORMULAE FOR WATERPROOFING TEXTILES PATENTED IN THE UNITED STATES, GREAT BRITAIN, FRANCE AND GERMANY SINCE THE YEAR 1900.

UNITED STATES. 1900-1923.

Date of Patent	*Number*	*Title or Description*	*Inventor*
July 17, 1900	653,715	Apparatus for electrically treating fabrics for waterproofing or other purposes.	J. T. Van Gestel
July 17, 1900	653,716	Process of waterproofing fabrics.	J. T. Van Gestel
Aug. 20, 1901	680,734	Process of making waterproof fabric and product thereof.	A. M. Posener
Jan. 7, 1902	690,868	Process of waterproofing fabrics.	J. Menzies
May 19, 1903	728,234	Paraffin fabric.	C. C. Hoyt
June 16, 1903	731,002	Method of waterproofing and rotproofing textile fabrics.	J. Williams
Feb. 20, 1906	813,218	Process of rendering materials resistant to water and chemicals.	C. Kochmann
May 15, 1906	820,694	Waterproof fabric.	L. A. Bond
June 4, 1907	855,708	Process of treating cloth.	S. Hermann
Dec. 17, 1907	874,101	Waterproof fabric.	E. Meron
April 20, 1909	919,031	Process for rendering material of any kind proof against the action of moisture and of chemical agents.	A. Kronstein
May 11, 1909	921,001	Manufacture of waterproof articles from fibrous materials.	I. L. Roberts
June 1, 1909	923,176	Waterproofing preservative dressing.	J. H. Hockcher

UNITED STATES. 1900-1923.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Aug. 16, 1910	967,379	Belting (waterproof).	J. W. Hilton
Nov. 8, 1910	974,855	Fabric (waterproof).	P. L. Bonsquet
Feb. 21, 1911	984,665	Process of rendering ramie and other fabrics water repellent and coloring the same.	A. M. Hart
April 4, 1911	988,388	Composition for treating canvas and other fabrics.	M. A. Rolssig
June 13, 1911	994,931	Method of waterproofing fabrics.	P. O. Keilholtz
June 27, 1911	996,325	Method of treating canvas for special purposes.	C. W. Foster
May 7, 1912	1,025,731	Process for waterproofing linen or other textile articles and giving them a permanent glazed washable surface.	A. A. Zimmer
Dec. 22, 1914	1,121,647	Waterproofed textile material and process of making same.	A. R. Marr
Dec. 22, 1914	1,121,648	Process of waterproofing textile material and product thereof.	R. A. Marr
Mar. 23, 1915	1,132,687	Process for making waterproof materials and coating.	J. F. Ryan
April 20, 1915	1,136,370	Fire and waterproof composition and process of preparing the same.	J. A. Scharwath
June 1, 1915	1,141,136	Fireproof and waterproof covering and process of making.	M. J. Moeller

Date of Patent	*Number*	*Title or Description*	*Inventor*
June 20, 1916	1,187,890	Fabric and process for making the same.	R. G. Dunwody
Oct. 31, 1916	1,202,803	Process of waterproofing material and product.	W. A. Carter
June 5, 1917	1,228,458	Process of impregnating fabrics with rubber.	I. S. McGichan
July 3, 1917	1,231,687	Waterproof fabric and coating.	W. H. Adams
Oct. 9, 1917	1,242,327	Waterproofing of fabrics.	E. I. Cuthbertson
Mar. 5, 1918	1,258,104	Method of waterproofing and rendering impervious to dust, bags, sacks and the like.	J. Gadsden
July 23, 1918	1,273,213	Fireproofing and waterproofing composition.	C. F. Frohe
Oct. 8, 1918	1,280,954	Process for waterproofing fibrous material.	P. F. Bovard
June 10, 1919	1,306,274	Process for waterproofing fabrics.	J. E. Paquet
June 24, 1919	1,307,373	Method of waterproofing fabrics.	H. P. Pearson
Aug. 19, 1919	1,313,658	Process of producing wall covering and product thereof.	R. H. Wiggin
Aug. 26, 1919	1,314,477	Method and means for making prepared roofing elements.	F. C. Overbury
Oct. 28, 1919	1,320,353	Water repellant material and method of producing the same.	J. F. White
Dec. 30, 1919	1,326,630	Method of waterproofing garments.	W. S. Barker
Feb. 10, 1920	1,330,443	Waterproof material.	G. C. Glynn
Feb. 17, 1920	1,331,365	Process for applying waterproofing to materials and the products therefrom.	R. P. Perry

UNITED STATES. 1900-1923.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
July 20, 1920	1,347,095	Waterproof fabric and process for producing the same.	A. B. Harrison
Aug. 17, 1920	1,349,910	Waterproofed fabric.	W. B. Pratt
Sept. 7, 1920	1,352,163	Coated fabric and process of producing the same.	J. A. Wilson
June 14, 1921	1,381,413	Fabric for airships and process of making same.	H. A. Gardner
Mar. 7, 1922	1,408,871	Waterproof fabric and process of making same.	E. H. Enos
April 4, 1922	1,411,786	Process of treating fibrous material and product thereof.	E. Hopkinson
Aug. 29, 1922	1,427,230	Insulating material.	F. Salathe, Jr.
Oct. 24, 1922	1,432,833	Waterproofing cloth.	C. Bionelo
Oct. 2, 1923	1,469,606	Waterproofing product and process of making same.	C. E. Rohr et al.

BRITISH PATENTS. 1900-1923.

Date of Patent	*Number*	*Title or Description*	*Inventor*
Feb. 10, 1900	2,703	Waterproof materials; waterproofing by electrolysis.	H. W. Schlomann and A. de Castro
—— — 1900	5,594	Process and composition.	G. G. Hepburn
Mar. 30, 1900	5,994	Waterproofing; waterproofing — compositions waterproof fabrics.	F. W. Golby
May 4, 1900	8,267	Coated fabrics.	C. Baswitz

Date of Patent	*Number*	*Title or Description*	*Inventor*
May 14, 1900	8,857	Coated fabrics. Waterproofing compositions.	Baron N. Tornauw
July 17, 1900	12,910	Coated fabrics. Waterproofing compositions.	J. C. Fell
Dec. 21, 1900	23,388	Coated fabrics; waterproof materials; waterproof fabrics, waterproofing compositions; fabrics, imitation of textile.	M. Dickmann
Jan. 17, 1901	1,160	Coated fabrics.	J. E. Bousfield
Feb. 7, 1901	2,679	Waterproofing; waterproofing compositions; coated fabrics.	A. Kronstein
—— — 1901	8,063	Coating composition.	A. Browne
Jan. 29, 1901	13,562	Waterproofing; waterproof fabrics; waterproofing compositions.	A. Bachelard and P. Grenet
July 10, 1901	14,106	Coated fabrics; waterproofing compositions.	G. Dutilleul
Aug. 6, 1901	15,829	Waterproofing compositions.	F. M. Wharton
Sept. 24, 1901	19,013	Copper ammonia solution.	J. Williams
Oct. 2, 1901	19,656	Coated fabrics.	F. Rushworth
—— — 1901	20,281	Waterproofing composition.	G. M. Port
June 5, 1902	12,807	Waterproofing; waterproofing compositions; waterproof fabrics.	J. Menzies
Nov. 12, 1902	24,864	Coated fabrics; waterproof fabrics; waterproofing compositions.	W. W. Pilkington and W. R. Ormandy
May 3, 1902	10,128	Waterproofing compositions and coated fabrics.	A. Luft

BRITISH PATENTS. 1900-1923.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Jan. 5, 1903	218	Coated fabrics.	W. M. Mackintosh and A. Smith
April 16, 1903	8,635	Waterproofing; coated fabrics.	T. F. Wiley
April 16, 1903	8,636	Waterproofing; coated fabrics.	T. F. Wiley
Aug. 18, 1903	17,857	Coated fabrics.	C. Lichtenstadt
Aug. 28, 1903	18,599	Waterproof fabrics; coated fabrics.	L. J. Chischin
Nov. 17, 1903	25,000	Coated fabrics; waterproofing; waterproofing compositions.	V. B. Wright, W. K. Polson, W. M. Mackintosh
Jan. 26, 1904	1,930	Coated fabrics; waterproofing; waterproof fabrics.	G. Murray
Jan. 28, 1904	2,167	Coated fabrics; waterproofing compositions.	P. C. D. Castel
Mar. 25, 1904	7,172	Coated fabrics.	T. F. Wiley
April 12, 1904	8,433	Waterproofing; waterproofing compositions.	S. Serkowski
April 3, 1905	7,041	Waterproof fabrics.	O. Stuart
April 27, 1905	8,875	Waterproofing compositions; coated fabrics.	W. H. Story
July 28, 1905	15,518	Waterproofing compositions; waterproofing.	M. Pomortzeff
Aug. 18, 1905	16,744	Waterproofing; waterproofing compositions.	C. Kochman, J. Kaufmann
Aug. 23, 1905	17,057	Waterproofing compositions.	J. A. Shepherd

Date of Patent	Number	Title or Description	Inventor
Oct. 18, 1905	21,125	Waterproofing compositions; waterproof fabrics.	A. J. Boult
Nov. 19, 1904	23,787	Coated fabrics; waterproof fabrics; waterproofing; waterproofing compositions.	H. O. Brandt
Nov. 28, 1905	24,622	Coated fabrics; waterproofing compositions.	H. E. Kershaw
Jan. 31, 1906	2,471	Coated fabrics; waterproof fabrics.	A. J. Boult
Feb. 24, 1906	4,577	Waterproofing compositions; coated fabrics.	R. H. Annison, G. T. Oliver
Mar. 2, 1906	5,169	Coated fabrics; waterproofing compositions.	J. H. Laureau
Oct. 31, 1906	24,308	Waterproofing compositions; coated fabrics.	J. Pering
Feb. 20, 1907	4,268	Waterproofing compositions; coated fabrics.	P. C. H. West
Mar. 1, 1907	5,016	Waterproofing compositions; waterproof fabrics.	J. F. Briggs and C. F. Cross
May 30, 1907	12,556	Waterproofing compositions; coated fabrics.	H. Dugour
July 18, 1907	16,520	Coated fabrics.	S. Ebizuka
Oct. 10, 1907	22,371	Waterproofing compositions; coated fabrics.	J. R. Morison
Feb. 14, 1908	3,297	Coated fabrics.	H. Mackintosh
Mar. 9, 1908	5,279	Waterproofing compositions; coated fabrics.	E. S. Cohen
April 10, 1908	7,972	Coated fabrics; waterproof fabrics.	R. Hubner and J. H. Riley & Co.
June 17, 1907	12,980	Coated fabrics; waterproofing compositions.	R. Eberhard
June 29, 1908	13,792	Coated fabrics; waterproofing compositions.	R. Eberhard

BRITISH PATENTS. 1900-1923.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Sept. 3, 1908	18,493	Coated fabrics; waterproofing compositions.	Mertens & Company, H. Jerosch, H. Lyncke
Dec. 21, 1907	25,522	Waterproof fabrics.	C. R. Baumann and G. G. Diesser
May 13, 1909	11,340	Coating compositions; impregnating compositions.	A. M. Hart
Aug. 26, 1908	16,199	Coating compositions; coating webs.	G. Gawlich
July 27, 1909	17,499	Coating compositions; impregnating compositions.	A. Douque
Aug. 27, 1909	19,213	Impregnating compositions.	A. O. Tate
Aug. 27, 1909	19,696	Coating compositions; impregnating compositions.	J. M. Talmadge
Sept. 28, 1909	22,111	Waterproofing.	J. H. Ketcheson
Oct. 19, 1909	24,006	Coating compositions; glazed linen and the like.	A. A. A. Zimmer
Dec. 30, 1909	20,510	Coating compositions; backings.	J. H. C. Gebauer
Jan. 10, 1910	636	Coating compositions.	L. Lilienfeld
Jan. 12, 1910	870	Coating compositions.	H. Peters
Jan. 25, 1909	1,799	Coating compositions; impregnating compositions.	W. Bruckner
Feb. 24, 1910	4,593	Backings.	G. Chapman

Date of Patent	*Number*	*Title or Description*	*Inventor*
Aug. 6, 1910	18,607	Coating compositions.	A. M. Hart
Oct. 22, 1910	24,593	Coating compositions.	F. Stevenson and G. S. Hamilton
Nov. 17, 1910	26,789	Coating compositions.	E. A. Muskett and Rubber Substitute, Ltd.
Nov. 19, 1910	26,928	Coating materials and compositions; impregnating compositions.	L. Lilienfeld
May 4, 1911	6,910	Coating compositions.	W. H. Kemp
Aug. 1, 1911	17,461	Impregnating compositions.	D. O'Keefe
Sept. 13, 1911	20,297	Compound fabrics; waterproof fabrics; waterproofing.	J. Hoyle and A. J. Milne Smith
Mar. 20, 1911	6,814	Impregnating compositions.	E. T. J. Watremez
May 26, 1911	7,555	Coating materials.	B. Chapiro and N. Hornstein
May 22, 1912	12,128	Backings; coating compositions.	J. Mendess
June 22, 1912	14,665	Coating compositions.	G. d'Ameida
July 8, 1912	15,965	Coating compositions.	W. Kaempfe
July 10, 1912	16,156	Coating compositions; ornamenting.	D. M. Sutherland
Sept. 24, 1912	21,697	Coating compositions; impregnating compositions.	G. T. and H. Oliver

British Patents. 1900-1923.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Jan. 6, 1912	305	Impregnating compositions.	Walther Freiherr von Reinold
Mar. 16, 1912	6,387	Impregnating compositions; coating compositions.	L. Lilienfeld
Oct. 18, 1912	21,943	Impregnating compositions.	T. D. Kelly
Oct. 22, 1913	23,957	Coating compositions.	B. Hansel
Feb. 25, 1914	4,955	Rubbered fabrics treated with acid-neutralizing substances.	W. E. Muntz
April 8, 1914	8,902	Backings.	P. F. Allen
June 2, 1914	13,467	Impregnating compositions.	F. Eichenberger
Dec. 8, 1914	23,709	Impregnating compositions.	F. Waterhouse and S. Alexander
Mar. 22, 1915	4,494	Fabrics impregnated before coating.	W. Kohlschutter, G. Rothmund and G. Rothmund & Company
April 26, 1915	6,189	Impregnating compositions.	S. Salomon
Jan. 27, 1916	101,741	Proofing.	N. Gekoulin
Feb. 19, 1916	101,749	Proofing.	H. C. Pritham
June 21, 1916	104,986	Water solutions of chemical compounds for proofing.	A. Maltman

Date of Patent	Number	Title or Description	Inventor
Aug. 28, 1916	108,376	Non-drying proofing compositions.	E. W. Adams and S. G. W. Farthing
Nov. 1, 1916	108,085	Proofing.	A. O. Tate
Nov. 8, 1916	109,691	Water solutions of chemical compounds for proofing.	J. L. Wahnrow
April 17, 1917	114,494	Water solutions of chemical compounds.	J. D. Williams
Dec. 4, 1917	129,712	Proofing; emulsions for proofing.	F. Cochrane
Mar. 9, 1918	130,672	Water solutions of chemical compounds for proofing.	F. Cochrane
July 31, 1918	130,731	Proofing.	J. E. Carter, S. A. Wright, W. Ratcliffe
Feb. 24, 1919	145,611	Proofing.	F. Moeller
June 26, 1919	146,099	Proofing.	A. Arent
June 29, 1920	145,610	Proofing.	F. Moeller
1920	147,310	Preservative and waterproofing compositions.	C. H. Murray
1921	156,776	Proofing fabrics.	Mehler, Segeltuchweberei Akt. Ges. V.
1921	158,366	Balloon fabric, etc.	C. A. Cleghorn
1921	160,627	Fireproofing, waterproofing, and metallizing lace, etc.	A. Norweb
1921	164,730	Fireproofing and waterproofing.	A. Arent
1921	171,726	Waterproofing fabrics.	W. A. Mitchell

BRITISH PATENTS. 1900-1923.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
1922	177,566	Proofing fabrics, wood, etc.	S. J. Peachey
1922	179,247	Dyeing and waterproofing.	A. O. Tate
1922	183,249	Treating fibres.	A. G. Bloxam
1922	184,462	Waterproofing.	F. Moeller
1923	191,455	Showerproof fabrics.	Semon & Co., Ltd.
1923	201,421	Proofing fabrics.	T. Macwalter & Brifco, Ltd.

FRANCE. 1900-1922.

Date of Patent	*Number*	*Title or Description*	*Inventor*
Mar. 3, 1900	287,286	Nouveau procédé pour rendre les objets imperméables.	Hepburn
Mar. 20, 1900	298,401	Perfectionnements aux appareils à imperméabiliser les tissus et qui sont applicables à d'autres objets.	Miller
April 6, 1900	298,989	Procédé pour rendre ignifuges et imperméables les tissus de tous genres.	Baswitz
June 12, 1900	301,284	Système d'imperméabilisation des tissus.	Serkowski
June 22, 1900	302,497	Nouvelle composition pour rendre imperméable les étoffes et autres applications analogues.	Heather
July 17, 1900	302,263	Procédé pour le traitement électro-galvanique des tissus.	Sté G. & P. de Mestral

Date of Patent	*Number*	*Title or Description*	*Inventor*
Nov. 8, 1900	305,222	Procédé d'imperméabilisation des étoffes, pour habillement civil et militaire.	Gilbert
Nov. 19, 1900	305,500	Procédé pour l'imperméabilisation des tissus.	Baswitz
Jan. 5, 1901	306,852	Procédé pour rendre les matières textiles imperméables.	Leclercq
Jan. 29, 1901	307,607	Procédé d'imperméabilisation des draps, tissus et étoffes, feutres, velours, plumes, etc.	Grenet and Bachelard
April 5, 1901	309,961	Applications nouvelles de la caséine dans le but de l'utiliser pour en former des lamelles et des feuilles ainsi que pour la fabrication des tissus imperméables ressemblant aux toiles cirées, caoutchoutées ou vernies.	Cantu, Miglioretti and Maffei
May 15, 1901	310,857	Nouveau procédé d'imperméabilisation des tissus et autres produits.	Dutilleul
May 22, 1901	311,868	Procédé d'imperméabilisation absolue des draps, tissus, etc.	Toussaint
Aug. 23, 1901	313,740	Procédé pour la formation d'un enduit brillant sur le cuir, le papier, les étoffes, etc.	Colm
Sept. 29, 1902	324,856	Enduit pour couverture imperméable ou prélats.	Peters and Shepherd
Oct. 1, 1902	324,885	Composition pour la fabrication de linoléum, toile cirée, prélats et autres articles recouverts d'un enduit.	Peters and Shepherd

FRANCE. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Mar. 22, 1902	331,135	Enduit rendant les tissus imperméables.	
May 5, 1902	331,480	Nouveau procédé d'imperméabilisation des tissus.	Molino
May 20, 1902	331,264	Procédé pour coller, durcir et rendre inattaquables à l'eau toutes espèces de papiers, tissus, bois, amiante et matières fibreuses analogues.	Luthringer
April 30, 1903	331,602	Procédé pour imperméabiliser les tissus.	Meyer
June 2, 1903	332,671	Nouveaux modes d'application de la gélatine sur tissus et produits qui en dérivent.	Schrader
Nov. 23, 1903	336,889	Produit et machine pour imperméabiliser les étoffes et tissus, fils, cordes, ficelles, etc.	Renard
Jan. 15, 1904	339,633	Liège transformé moléculairement et ses applications.	Wright, Poulsom, Mackintosh
May 17, 1904	343,240	Toile imperméable pour emballage.	Grimoin-Sanson
Aug. 1, 1904	345,298	Application aux tissus et étoffes de liège transformé moléculairement et réduit en poudre.	Bourdu & Cie
Nov. 28, 1904	348,340	Appareil propre à l'imperméabilisation des tissus tubulaires.	Grimoin-Sanson
Mar. 29, 1905	360,946	Imperméabilisation des textiles.	Smith
			Cottin and Four

Date of Patent	*Number*	*Title or Description*	*Inventor*
July 28, 1905	356,497	Procédé de traitement des étoffes draps, papiers et autres substances en vue d'en assurer la solidité et l'imperméabilisation.	Pomortzeff
Oct. 18, 1905	358,619	Tissus imperméables et leur procédé de fabrication.	Lon & Bond
Dec. 21, 1905	361,284	Procédé pour l'imperméabilisation des étoffes.	Geisenberger
Feb. 6, 1906	371,981	Tissu hydrofuge et lavable pour tentures.	Merou
Feb. 15, 1906	363,307	Procédé de fabrication d'une étoffe imperméable et lavable imitant le velours.	Keffel and Meinel
Oct. 8, 1907	392,870	Procédé pour rendre certains tissus imperméables.	Blum
Nov. 25, 1907	394,414	Procédé de caoutchoutage des tissus.	Hernandez
Feb. 21, 1908	387,431	Tissu imperméable propre à la constitution d'étuves facilement transportables et à d'autres applications.	Dufayard and Dechosal
June 12, 1908	400,614	Nouveau procédé d'application du liège en poudre impalpable aux étoffes et tissus imperméables.	Lavergne
July 1, 1908	391,932	Procédé d'imperméabilisation des tissus.	Emmerling
Aug. 28, 1908	394,657	Procédé pour imperméabiliser et rendre rigide tout tissu d'origine végétale.	Marsia
Nov. 19, 1908	396,467	Procédé de fabrication des toiles cirées, papiers cirés et leurs équivalents.	Siebert

FRANCE. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Jan. 4, 1909	398,502	Procédé pour l'imperméabilisation des fibres de jute, chanvre, lin, laine, et autres, notamment sous la forme de semelles.	Lainville
June 15, 1909	414,304	Procédé d'imperméabilisation des étoffes pour ballons et vêtements.	Morel
Dec. 11, 1909	421,078	Procédé et dispositifs pour imprégner enduire ou gommer des tissus ou autres matières ou surfaces poreuses.	Olier & Cie
Dec. 28, 1909	410,749	Imperméabilisation des fils et tissus.	Dickson
May 30, 1910	427,562	Composition pour apprêter, imperméabiliser et rendre ininflammables les tissus et fibres naturelles ou artificielles.	Achard and Gonon
Aug. 31, 1910	431,090	Procédé d'imperméabilisation des tissus légers.	Ratignier and Sté Pervillac & Cie
Sept. 7, 1910	420,127	Procédé d'imperméabilisation du linge.	Peters
Sept. 8, 1910	431,348	Composition nouvelle pour l'imperméabilisation des fils et tissus.	Dickson
Nov. 3, 1910	433,727	Procédé permettant d'obtenir rapidement l'imperméabilisation des tissus.	Rivat

Date of Patent	Number	Title or Description	Inventor
Nov. 24, 1910	422,917	Procédé de préservation ou d'imperméabilisation et d'ignifugation des fils et tissus ouvrés ounon.	Boucherie
Nov. 30, 1910	434,602	Procédé permettant de rendre imperméables les films, pellicules, fils, etc., en soie artificielle genre Chardonnet.	Bourgeois, Neuviarts et Mme. de Clucq (née Vandepitte)
Feb. 18, 1911	426,620	Procédé d'imperméabilisation et de glaçage des tissus.	Lormier
April 21, 1911	428,759	Procédé pour la préparation des toiles imperméables.	Remeau and Marchi
April 26, 1911	441,496	Procédé de solidification et d'imperméabilisation des tissus et du papier.	Hornstein and Chapiro
May 17, 1911	431,692	Procédé de préparation des tissus pour ailes d'aéroplanes, dirigeables et autres applications.	Ledru Heitz & Cie
Aug. 5, 1911	433,013	Perfectionnements apportés à l'imperméabilisation des tissus fils et autres matières.	Mme. Hart (née Rowland)
Aug. 16, 1911	430,601	Procédé d'imperméabilisation et de fixation des nuances, applicable aux bâches et toiles en tous genres, toiles d'emballage pour sacs, toiles imprimées, etc.	Delannoy and Boute

FRANCE. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Oct. 23, 1911	435,577	Procédé pour l'imperméabilisation et le tannage de fibres végétales ou animales telles que jute, chanvre, lin, ramie, alfa, coton, laine, soie et feutre, sous forme de semelles tissus sacs, notamment, ou toute autre forme.	Buret
Nov. 4, 1911	447,700	Appareil à enduire d'un produit liquide quelconque en surface marge ou rayures les papiers, cartons, toiles et tissus.	Groult
Dec. 9, 1911	448,928	Procédé de teinture et d'imperméabilisation.	Germain
Dec. 14, 1911	437,641	Tissu imperméable perfectionné.	Sté Michaut and Masson
Feb. 6, 1912	439,813	Etoffes imperméables (lamages grossieurs pour couvertures, feutre, etc.).	Wiesner
Mar. 26, 1912	441,740	Application des poudres de lycopode et de tannin aux tissus imperméables.	Chotin
July 2, 1912	447,278	Tissu composé de fibres textiles agglomérées avec du caoutchouc et procédé pour sa fabrication.	Hauvette
July 3, 1912	445,750	Appareil pour rendre les draps, buckskins, cheviottes, peignés, solides, imperméables, décatis, unis, plus maniables, plus pleins, plus souples et prêts à la couture.	Rudiger

Date of Patent	*Number*	*Title or Description*	*Inventor*
July 8, 1912	445,865	Procédé de fabrication d'un produit remplaçant la toile cirée ou matière analogue.	Kaempfe
July 8, 1912	445,884	Procédé d'imperméabilisation perfectionné.	Anderson & Sté Anderson Co., Ltd.
July 8, 1912	445,885	Perfectionnements dans l'imperméabilisation des tissus.	do.
July 12, 1912	446,021	Procédé de fabrication de tissus hydrofuges et aérifères.	Mme. Piontrel (née Louvet)
July 22, 1912	446,308	Procédé de fabrication d'un produit destiné à remplacer les toiles cirées et produits similaires et même le cuir dans leurs diverses applications.	Chaumont
July 29, 1912	446,627	Procédé de préparation des tissus pour ailes d'aéroplanes et autres.	Ledru, Heirtz & Cie
Nov. 5, 1912	461,743	Procédé de préparation et d'imperméabilisation des toiles ou tissus servant à la construction des aéroplanes, ballons, cerfs-volants.	Larco and Ronchetti
Dec. 16, 1912	452,677	Procédé de fixation de matières colorantes, de pigments ou de poudres métalliques au moyen des produits de condensation de la formaldéhyde avec les phénols, amines ou dérivés.	Sté de la Manufacture d'Indiennes Emile Zündel

FRANCE. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Dec. 23, 1912	463,691	Toile foulée imperméable à l'eau et procédé de fabrication.	Collet
Dec. 31, 1912	452,791	Perfectionnements, à la fabrication de feuilles imperméables pour la confection de draps de lits, bâches, tubes, etc.	Dew and Sté The Azerlay Syndicate
Jan. 13, 1913	453,092	Perfectionnements aux tissus pour enveloppes de ballons ou autres.	Porrit and The North British Rubber Co.
April 2, 1913	456,265	Procédé d'imperméabilisation des tissus et autres objets de matière textile.	Pontrel
April 21, 1913	456,925	Pellicule imperméable et procédé de fabrication.	Pluss
June 25, 1913	456,729	Composition pour rendre imperméable le linge empesé, spécialement fauxcols, etc.	Lichtenauer
July 10, 1913	460,226	Procédé pour imperméabiliser des tissus ou analogues.	Oliver
Aug. 2, 1913	461,058	Procédé pour l'obtention d'enduits à base d'acétate de cellulose sur étoffe ou toute autre matière.	Ag. für Anilin Fabrication

Date of Patent	*Number*	*Title or Description*	*Inventor*
Sept. 8, 1913	462,267	Appareil d'imprégnation et d'enduisage.	Destribats
Nov. 10, 1913	464,729	Apprêt intachable à l'eau par insolubilisation de gélatine.	Watremez
Dec. 5, 1913	474,145	Procédé pour le traitement des tissus en vue de leur imperméabilisation.	Cie Française d'injection pour la conservation des bois et tissus
Dec. 29, 1913	466,720	Procédé d'application sur un tissu d'une couche de matière adhésive.	Stoffel
April 30, 1914	471,540	Tissu contenant du caoutchouc et autre matière analogue.	Collier
May 30, 1914	472,844	Procédé d'imprégnation de matières fibreuses et textiles.	Tew
June 12, 1914	473,373	Procédé pour la préparation de produits tirés des algues marines, et leur application au traitement du papier, matières textiles, cuir, etc.	Ingham
Mar. 18, 1914	475,824	Tissu isolant, imperméable et armé pour applications diverses.	Gauthier
June 19, 1914	477,531	Procédé d'imperméabilisation de toutes matières en général.	Corat
Dec. 2, 1914	479,436	Procédé d'imperméabilisation des tissus.	Vincent and Pluszeski

FRANCE. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Feb. 19, 1915	477,767	Procédé d'imperméabilisation de matières poreuses telles que cuirs, tissus et papiers.	Magnin
Nov. 8, 1915	480,193	Pâte à imperméabiliser les tissus et les cuirs.	Silvant
Jan. 1, 1916	484,184	Procédés et produit pour imperméabiliser les tissus, etc.	Jourdan
April 26, 1916	481,629	Nouveau produit destiné à l'imperméabilisation de tous les tissus.	Gheise de St. Pierre
May 5, 1916	483,434	Perfectionnements apportés aux revêtements protecteurs et impénétrables.	Lynch
July 15, 1916	479,284	Tissus imperméables et leur procédé de fabrication.	Swain
Dec. 7, 1916	489,188	Procédé et appareil pour imperméabiliser les fibres, tissus et matières fibreuses.	Tate
Dec. 20, 1916	483,928	Procédé pour l'imperméabilisation des tissus et matières poreuses de tous genres.	Pateras-Pescara
Jan. 17, 1917	489,543	Procédé d'imperméabilisation des draps et textiles.	Baron and Bonnier
Sept. 29, 1917	486,988	Procédé d'imperméabilisation et de chamoisage de toiles imitation de peaux d'antilopes et veaux, velours.	Lestorte
Nov. 10, 1917	487,571	Procédé d'imperméabilisation des draps.	Bigot

Date of Patent	*Number*	*Title or Description*	*Inventor*
Nov. 28, 1917	487,958	Procédé pour imprégner et recouvrir les tissus de balata sans secours de dissolvants.	L. François & Cie
Mar. 12, 1918	496,542	Emploi de vernis à base de produits de condensation des phénols et d'aldéhydes pour la tension et l'imperméabilisation des toiles et tissus.	Schwing
April 9, 1918	489,652	Perfectionnements aux appareils pour imprégner ou traiter les tissus.	Taylor
April 19, 1918	489,672	Procédé d'imperméabilisation applicable à tous tissus.	Monlong
July 6, 1918	497,744	Composition adhésive, applicable notamment à l'imperméabilisation des tissus.	Etablissements Hutchinson
May 7, 1919	499,162	Appareil vertical pour le gommage et le séchage rapide des tissus.	Etablissements A. Olier
Dec. 22, 1919	521,523	Produit pour l'imperméabilisation, le tannage et la conservation de substances telles que tissus, papiers, bois et autres, et procédé de fabrication.	Sivet
Feb. 11, 1920	509,814	Procédé d'imperméabilisation et de renforcement des fils et tissus.	La Soie Artificielle de la Voulte

FRANCE. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
June 22, 1920	517,604	Composition pour l'imperméabilisation des étoffes, draps, feutres, etc.	Ply
June 28, 1920	518,056	Procédé pour apprêter et imperméabiliser des fibres filés et tissus.	Blanke and Weingärtner
July 3, 1920	518,547	Perfectionnements aux tissus imperméabilisés.	Pratt
Nov. 22, 1920	527,764	Nouveau procédé d'imperméabilisation.	Martin
Dec. 1, 1920	527,820	Perfectionnements aux tissus recouverts d'un enduit ou revêtement et procédé pour la fabrication de ces tissus.	The Durale Co.
Feb. 3, 1921	534,501	Perfectionnement aux procédés pour teindre et imperméabiliser.	Tate
Mar. 30, 1921	533,012	Procédé d'imperméabilisation des tissus.	Pearson
July 26, 1921	549,814	Procédé réalisant la transformation en simili peau des étoffes de contexture végétale.	Jaloux
Oct. 7, 1921	542,079	Perfectionnements apportés à la fabrication des toiles goudronnées dites toiles grasses pour emballages maritimes.	Gaudier and Kuppel
Oct. 8, 1921	542,100	Tissu imperméable d'aspect métallique.	Lang Verte & Cie

Date of Patent	Number	Title or Description	Inventor
Jan. 19, 1922	548,911	Procédé d'imperméabilisation et de teinture des toiles.	Mme. Herchelbout épouse Destriez
April 7, 1922	549,865	Traitement des tissus à imperméabiliser, en vue d'augmenter leur imperméabilité et leur souplesse.	Noteris
June 1, 1922	552,439	Procédé et installation pour le fonctionnement de machines à enduire les étoffes.	Martini and Huneke Maschinenbau A. G.
Aug. 9, 1922	554,989	Machine à enduire les étoffes en pièces.	do.
Aug. 18, 1922	555,213	Procédé d'imperméabilisation et de conservation des tissus et analogues.	Lemaire
Sept. 27, 1922	556,577	Procédé pour ignifuger et imperméabiliser les tissus et papiers en tous genres.	Hirschler

GERMANY. 1900-1922.

Date of Patent	Number	Title or Description	Inventor
Jan. 4, 1900	137,216	Verfahren zur Herstellung einer wasserdichten, plastischen Masse, die namentlich zum Wasserdichtmachen von Geweben geeignet ist.	Gebr. Hansel

GERMANY. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Feb. 17, 1900	119,101	Verfahren zum Wasserdichtmachen von Faserstoffen durch unlössliche Schwermetall—Wolframate und Oel—oder Fettsäuren oder dergleichen.	G. G. Hepburn
June 17, 1900	127,582	Verfahren zum Dichtmachen von Geweben durch Asphalt Emulsion.	Caut Baswitz
July 18, 1900	126,594	Apparat zur elektrogalvanischen Behandlung von Geweben behufs Wasserdichtmachens.	J. T. van Gestel
Sept. 7, 1900	129,450	Verfahren zum Wasserdichtmachen von Gewebe, Leder, Papier, Pappe oder dergl.	Stanislaus Serkowski
Dec. 11, 1900	128,988	Verfahren zur Herstellung von wasserdichten Handschuhen und anderen, der Krankenpflege dienenden Gegenständen aus Darmoberhautleder und Kautschuk oder Gummi.	Bruno Trenckmann
Dec. 25, 1900	141,411	Verfahren, um Stoffe unter Erhaltung ihrer Luft—und Schweissdurchlässigkeit wasserdicht zu machen.	Alois Bolom
April 19, [illegible]	131,960	Verfahren zur Herstellung wasserdichter Gewebe unter Zuhilfenahme von Wollstaub	Edward Turner Whitelow

Date of Patent	*Number*	*Title or Description*	*Inventor*
May 5, 1901	128,174	Verfahren zur Tränkung von Baumwoll—Treibriemen oder Seilen auf kaltem Wege.	Bruno Reichelt
April 16, 1902	147,029	Verfahren, um Stoffe oder Gegenstände wasserfest und zugleich luftdicht zu machen.	Eduard Mertens und Fritz Dannert
Oct. 4, 1902	153,060	Verfahren zur Herstellung wasserdichter Stoffe.	Melville Gordon Peters und Jams Altken Shepherd
Dec. 5, 1902	180,489	Verfahren zur Herstellung von wasserdichtem Stoff aus Geweben mittels Füllmasse und Lacküberzugs.	Jean Baptiste Germueil Bonnand
May 12, 1904	166,350	Verfahren zum Wasserdichtmachen von Faserstoffen (Gespinsten, Geweben, Leder, Papier und dergl.)	H. Noerdlinger
Aug. 7, 1904	187,027	Verfahren zur Herstellung eines Imprägniermittels zum Wasserdichtmachen von Persennings, Planen, Segeln Zelten und dergl.	Alfons Homeyer
Jan. 21, 1905	179,698	Verfahren zum gleichzeitigen Wasserdichtmachen und Färben von Pflanzenfaserstoffen.	H. Noerdlingen

GERMANY. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Mar. 10, 1905	167,168	Verfahren zur Herstellung einer zur Imprägnierung geeigneten, gegen Wasser und Chemikalien beständigen Masse.	Fa. C. I. G. Moennig & Co.
Sept. 27, 1905	187,028	Verfahren zur Herstellung einer zur Imprägnierung und zum Anstrich geeigneten, gegen Wasser und Chemikalien beständigen Masse.	Julius Kaufmann
Jan. 12, 1912	262,552	Verfahren zur Herstellung eines Imprägnierungsmittels mit Hilfe von Viskose und Kautschuck.	Fa. Pose
Oct. 26, 1912	285,138	Verfahren zur Herstellung von wasserdichten Geweben und Stoffen.	Frank E. Barrows
Jan. 26, 1913	271,251	Verfahren zur Herstellung von gegen Wasser und Feuchtigkeit widerstandsfähigen Appreturen.	E. T. J. Watremez
July 4, 1913	286,120	Verfahren zur Herstellung wasserdichter Stoffe durch Imprägnieren von Textilstoffen mit Lösungen aus Zellulose—Estern und Rizinusöl.	Eduard Girzik und Wilhelm Golombek
Aug. 15, 1913	278,717	Verfahren zur Herstellung imprägnierter Stoffe.	

Date of Patent	*Number*	*Title or Description*	*Inventor*
Sept. 7, 1913	275,659	Verfahren zum Haltbarmachen, insbesondere Wasserdichtmachen von Schiffstauen, Netzleinen und dergl.	Wilhelm Borks
Nov. 4, 1913	285,049	Verfahren zur Tränkung von Stoffriemen und -bändern unter Verwendung von Asphalt.	Aktiesels - Kabet Roulunds
Jan. 27, 1914	306,518	Verfahren zur Herstellung von gegen Feuchtigkeit und dergl. nicht empfindlichen Triebriemen aus durchgewebtem Kamelhaar-Baumwoll, oder ähnlichem Stoff mit beiderseitiger Balataimprägnierung.	G. Rothmund & Co.
May 2, 1914	286,740	Verfahren zur Imprägnierung von Ballonhüllen und Flugzeugflächen.	Augustinus Stefanowski
July 30, 1914	283,443	Verfahren zum Imprägnieren von Spindelschnuren.	Fa. H. Wilhelm Knoll
Oct. 28, 1914	365,284	Verfahren zur Imprägnierung von Faserstoffen.	Richard Wolffenstein und Arthur Marcuse
May 13, 1915	294,309	Verfahren zur Herstellung eines Kupfer und Holzteer enthaltenden Imprägnierungsmittels für Fischnetze usw.	Henrik Janson Bull

GERMANY. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
June 19, 1915	292,214	Verfahren zur Herstellung von Fäden, die den geknüpften Hanf ersetzen.	Fibern Manufactur A-G
Dec. 9, 1915	314,969	Verfahren zum Appretieren und Wasserdichtmachen von Geweben.	Erwin Naefe
Feb. 26, 1916	294,730	Hutappretur.	William Philippthal
July 22, 1916	299,771	Verfahren, Papiergarn oder Papiergewebe zu imprägnieren.	Theodor Dittmann
Dec. 16, 1916	307,111	Verfahren zum Wasserabstossendmachen von Textilwaren.	Farbenfabriken vorm. Friedrich Bayer & Co.
Dec. 21, 1916	335,298	Verfahren und Vorrichtung zum Wasserdichtmachen von Fasern und Faserstoffen.	Alfred O. Tate
Jan. 23, 1917	303,891	Verfahren zur Herstellung wasserfester Gewebe.	Badische Anilin und Sodafabrik
Feb. 9, 1917	302,531	Imprägnierungsmittel.	Farbenfabrik vorm. Friedrich Bayer und Co.
April 12, 1917	332,473	Verfahren zur Herstellung wasserfester Imprägnierungen auf Papiergarn und -geweben.	H. Th. Boehme A-G

Date of Patent	*Number*	*Title or Description*	*Inventor*
June 26, 1917	305,024	Verfahren zur wasserdichten Imprägnierung von Papiergeweben und Erzeugnissen aus Papiergeweben.	Max Linke
Aug. 2, 1917	303,390	Verfahren zum Wasserdicht und Wetterfestmachen von Geweben.	Badische Anilin und Sodafabrik
Aug. 11, 1917	316,099	Verfahren zum Imprägnieren von Stoffen.	Leo Ubbelohde
Oct. 18, 1917	346,061	Verfahren zur Herstellung wasserfester Imprägnierungen auf Papiergarngeweben.	H. Th. Boehme A-G
May 24, 1918	309,131	Verfahren zum Wasserdichtmachen von Textilstoff.	Leo Meyer
July 2, 1918	359,039	Verfahren zum Imprägnieren von Stoffen aller Art, wie Gewebe, Papier, Pappe, Holz mit löslicher Kieselsäure.	Farbenfabrik vorm. Friedrich Bayer und Co.
July 4, 1918	312,686	Verfahren zur Imprägnierung von Textile und Papiergarngeweben oder Geflechten.	Deutsche Pyroxit Gesellschaft
Dec. 13, 1918	314,968	Verfahren zum Wasserdicht und Weichmachen von Textilstoffen.	Leo Meyer

GERMANY. 1900-1922.—(*Continued*)

Date of Patent	*Number*	*Title or Description*	*Inventor*
Mar. 22, 1919	383,431	Verfahren zum Imprägnieren von Fasern, Faser- und Zellstoffen, Geweben, Papier und ähnlichen Stoffen mit Kautschuck.	Runge-Werke
Jan. 9, 1920	342,410	Verfahren, um Stoffe gegen Feuer und Flammen, sowie Wettereinflüsse und Feuchtigkeit widerstandsfähiger zu machen.	Arthur Arent
Feb. 3, 1920	382,086	Verfahren zur Erhöhung der Festigkeit, insbesondere der Nassfestigkeit von Kunstseide, Stapelfaser und von aus ihnen hergestellten Geweben.	Hans Karplus
Oct. 8, 1920	351,453	Imprägnierungsmasse und Verfahren zu ihrer Darstellung.	Norsk Hydro-Elektrisk Kvaelstofaktee Selskab
Jan. 5, 1921	350,805	Verfahren zum Undurchlässigmachen und zum Verstärken von Garnen und Geweben.	La Société "La Soie Artificielle de la Voulte"
Mar. 15, 1921	367,212	Verfahren, faserige, Grundgewebe zu imprägnieren.	William Beach Pratt

Date of Patent	Number	Title or Description	Inventor
Jan. 28, 1922	363,703	Verfahren zum Imprägnieren von Pflanzlichen, tierischen und mineralischen Faserstoffen, Garnen und Geweben.	Victor Scholz
Mar. 3, 1922	379,504	Verfahren zur Herstellung eines fäulnissicheren und wasserfesten Stoffriemens.	Theis und Kochmann
June 24, 1922	377,659	Verfahren zur Herstellung von wasserfesten Faserstoffbahnen aus Textilien, Papier usw. mittels Tränkung mit Metallchloriden.	Carl Knopf

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